SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST 1911.

CONTENTS.

GENERAL PHYSICS.

PAGE

977. Friction. *E. H. Hall* 337
978. Buckling of Thin-walled Cylinders. *R. Lorenz* 337
979. Tests on Nickel-steel Details for Quebec Bridge 338
980. Flexure of Flat Circular Plates. *P. T. Steinthal* 338
981. Some Causes of Failure in Metals. *H. Fay* 338
982. Resistance to Slipping of Iron in Concrete. *C. Bach* 338
983. Breath Figures. *Rayleigh* 339
984. Comparison of Chronometers by Wireless. *Claude, Ferrié, & Driencourt* 339
985. Continuous Change in Density during Fusion. *W. J. Lyons* 339
986. Determination of Density of Liquids. *H. Hartley & W. H. Barrett* 340
987. Surface Tension of a Liquid from Weight of Falling Drop. *J. L. R. Morgan* 340
988. Drop Weight of Non-associated Liquids. *J. L. R. Morgan, E. G. Thomssen, & G. H. Daghlian* 341
989. Harmonic Analysis Diagrams. *R. Beattie* 342
990. Transformation from Quiet to Moving Systems. *P. Frank & H. Rothe* ... 342
991. Solar Radiation and Sky Polarisation. *H. H. Kimball* 342
992. Polarisation of Sky Light. *H. H. Kimball* 343
993. Temperature Distribution in Atmosphere. *W. H. Dines* 343
994. Solar Eclipse of April 28, 1911. *C. W. Raffety* 345
995. Changes on Jupiter. *O. Lohse* 345

PAGE
996. Physical Observations of Mars. *R. Jarry-Desloges* 345
997. Spectrum of Nova Lacertæ. *W. H. Wright* 345
998. Altitude of Aurora Borealis. *C. Störmer* 346
999–1006. References 346

LIGHT.

1007. Action of a Prism on Light. *G. Green* 347
1008. Anomalous Dispersion. *W. H. Julius & B. J. van der Plaats* 347
1009. Interference Fringes of a Linear Source. *C. Raveau* 347
1010. Neutral-tinted Screen for Photometry. *H. E. Ives & M. Luckiesh* 348
1011. Visibility of Radiation Recalculated. *P. G. Nutting* 348
1012. Origin of "White" on Lumière Plate. *A. Forster* 349
1013. The Photographic Plate. *W. D. Bancroft* 349
1014. Sulphide Toning of Bromide Prints. *W. F. A. Ermen & C. W. Gamble* 350
1015. Influence of Temperature on Spectra. II. *H. du Bois & G. J. Elias* ... 350
1016. Absorption Spectrum of Neodymium Chloride. *G. P. Baxter & T. S. Woodward* 350
1017. Absorption Spectra of Permanganates. *T. R. Merton* 350
1018. Air Spectrum. *G. A. Hemsalech* 351
1019. Spark Spectrum in Magnetic Field. *G. A. Hemsalech* 351
1020. Magnetic Field and Doppler-effect of Canal Rays. *H. Baerwald* 352
1021. Photographic Action of *Euphorbia peplus*. *H. G. Chapman & J. M. Petrie* 352
1022. Recent Advances in Fluorescence. *E. L. Nichols* 352
1023. Ultra-violet and Infra-red Phosphorescence. *W. E. Pauli* 353

HEAT.

1024. Influence of Pressure on Melting-points. *J. Johnston & L. H. Adams* ... 354
1025. Errors in Cooling Curves. *H. C. Hayes* 354
1026. Specific Heats of Solids at Low Temperatures. *H. Barschall* 354
1027. Initiation and Propagation of Explosions. *H. B. Dixon* 355
1028. Heat of Evaporation of Oxygen. *H. Barschall* 355

ELECTRICITY AND MAGNETISM.

1029. Electronic Charge. *J. Perrin* 356
1030. Electronic Charge. *J. Roux* 356
1031. Ionisation of Salt Vapours by Kathode Rays. *G. Moreau* 356
1032. Positive Ions from Oxidising Copper. *A. Campetti* 357
1033. Electrical Conductivity in Saturated Vapours. *C. Füchtbauer* 357
1034. Ionisation produced by Quinine Sulphate. *de Broglie* 357
1035. Branch Currents in Discharge Tubes. *J. Würschmidt* 357

PAGE
1036. Magnetic Field due to Kathode Rays. *A. Joffé* 358
1037. Electrical Conductivity of Argentic Sulphide. *H. V. Hayes* 358
1038. Electromagnetic Action of deflected Magnetic Ions. *O. M. Corbino* 359
1039. New Galvanomagnetic Effects. *O. M. Corbino* 359
1040. Dielectric Constants of Gases for H.F. Oscillations. *H. Rohmann* 360
1041. Dielectric Constant of Liquid Hydrides. *R. C. Palmer & H. Schlundt* ... 360
1042. Disappearance of the Electrical Resistance of Mercury at Helium Temperatures. *H. Kamerlingh Onnes* 361
1043. Work done in Magnetisation. *A. Leduc* 361
1044–1048. References 361

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1049. Decomposition of Water by U.V. Light. *A. Tian* 362
1050. Chemical Action of Canal Rays. *E. P. Perman* 362
1051. Alloys of Nickel and Cobalt with Chromium. *E. Haynes* 362
1052. Alloys of Mo with Ni, Mn with Tl, and Ca with Mg, &c. *N. Baar* 362
1053. Solid Solutions of Copper-Nickel by Diffusion. *G. Bruni & D. Meneghini* 363
1054. Study of Iron-Chromium Alloys. *P. Monnartz* 364
1055. Gases contained in Steels. *G. Charpy & S. Bonnerot* 365
1056. Solid Non-metallic Impurities in Steel. *H. D. Hibbard* 365
1057. Action of Steam on Iron at High Temperatures. *J. A. N. Friend, T. E. Hull, & J. H. Brown* 366
1058. Density and Concentration of Aqueous Solutions. *P. F. Gaehr* 366
1059. Thermodynamic Calculation of E.M.F.'s. II. *H. F. Halla* 366
1060. Electrolytic Potential of Hyposulphite Reactions. *K. Jellinek* 367
1061. Electrolytic Preparation of Hyposulphite. *K. Jellinek* 367
1062. The Element $Cu \mid Cu_2O$. Alkali $\mid H_2$ at 0°. *A. J. Allmand* 367
1063. Potential of Chlorine Electrode. *G. N. Lewis & F. F. Rupert* 368
1064. Standard Electrode with Alkaline Electrolyte. *F. G. Donnan & A. J. Allmand* 368
1065. Electrochemical Behaviour of Tin. *F. Foerster & J. Yamasaki* 368
1066–1067. References 368

AUTHORS' INDEX.

Adams, L. H., 1024.
Allmand, A. J., 1062, 1064.
Baar, N., 1052.
Bach, C., 982.
Baerwald, H., 1020.
Bancroft, W. D., 1013.
Barnes, H. T., 1000.
Barrett, W. H., 986.
Barschall, 1026, 1028.
Baxter, G. P., 1016.
Beattie, R., 989.
du Bois, H., 1015.
Bonnerot, S., 1055.
Braak, C., 1001.
de Broglie, 1034.
Brown, J. H., 1057.
Bruni, G., 1053.
Butler, C. P., 1005.
Campetti, A., 1032.
Cannon, Miss, 1006.
Chapman, H. G., 1021.
Charpy, G., 1055.
Claude, 984.
Corbino, O. M., 1038, 1039.
Daghlian, G. H., 988.
Desloges, Jarry-, R., 996.
Dines, W. H., 993.
Dixon, H. B., 1027.
Donnan, F. G., 1064.
Driencourt, 984.
Elias, G. J., 1015.
Ermen, W. F. A., 1014.
Fay, H., 981.
Ferrié, 984.
Foerster, F., 1065.
Forster, A., 1012.
Frank, P., 990.
Friend, J. A. N., 1057.
Füchtbauer, C., 1033.
Gaehr, P. F., 1058.
Gamble, C. W., 1014.
Green, G., 1007.
Halla, H. F., 1059.
Hall, E. H., 977.
Hartley, H., 986.
Hayes, H. C., 1025.
Hayes, H. V., 1037.
Haynes, E., 1051.
Hemsalech, G. A., 1018, 1019.
Hibbard, H. D., 1056.
Holland, W. W., 1066.
Hull, T. E., 1057.
Ives, H. E., 1010.
Jarry-Desloges, R., 996.
Jellinek, K., 1060, 1061.
Joffé, A., 1036.
Johnston, J., 1024.
Julius, W. H., 1002, 1008.
Kalähne, A., 1047.
Kimball, H. H., 991, 992.
Krüger, F., 1045.
Leduc, A., 1043.
Lewis, G. N., 1063.
Lohse, O., 995.
Lorenz, R., 978.
Luckiesh, M., 1010.
Lyons, W. J., 985.
Meneghini, D., 1053.
Merton, T. R., 1017.
Meservey, A. B., 1046.
Monnartz, P., 1054.
Moreau, G., 1031.
Morgan, J. L. R., 987, 988.
Morse, H. L., 1066.
Myers, C. N., 1066.
Nichols, E. L., 1022.
Nutting, P. G., 1011.
Onnes, H. Kamerlingh, 1042.
Palmer, R. C., 1041.
Pauli, W. E., 1023.
Perman, E. P., 1050.
Perrin, J., 1029.
Petrie, J. M., 1021.
van der Plaats, B. J., 1008.
Raffety, C. W., 994.
Raveau, C., 1009.
Rayleigh, 983.
Rohmann, H., 1040.
Rothe, H., 990.
Roux, J., 1030.
Rupert, F. F. 1063.
Schlundt, H., 1041.
Steinthal, P. T., 980.
Störmer, C., 998.
Thomssen, E. G., 988.
Tian, A., 1049.
Volkmann, W., 999.
Walker, G. W., 1048.
Whitmell, C. H., 1004.
Wilkens, A., 1003.
Winston, L. G., 1067.
Witte, H., 1044.
Woodward, T. S., 1016.
Wright, W. H., 997.
Würschmidt, J., 1035.
Yamasaki, J., 1065.
Zies, E. G., 1066.

SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST 1911.

GENERAL PHYSICS.

977. *Friction.* E. H. Hall. (Science, 33. p. 775, May 19, 1911.)—Engineers generally assume that the coefficient of friction of metals on metals, wet, is considerably greater than that of metals on metals dry. Using a disc of brass about 7·5 cm. in diam. and about 0·6 cm. thick, on a flat brass plate, the author found (i) that, when there was no load on the disc, a few small drops of water placed between it and the plate multiplied the friction between the two surfaces by a factor which might be as great as 8 ; (ii) that, when the disc was heavily loaded the presence of the few small drops of water between it and the plate made little, if any, relative difference in the friction between the two surfaces ; (iii) that when plenty of water was used, so that it covered the whole of the space beneath the disc and extended somewhat beyond the edge, the disc without load was drawn along the plate quite as easily, apparently, as when both were dry. From these facts it is concluded that the increase of friction observed in the first case was not due to an increase in the coefficient of friction caused by the water, but merely to the increase of pressure between the disc and the plate, caused by the suction of the capillary perimeters of the water-spots between them. When there is much water its perimeter is outside the edge of the disc, is wide or thick, and has little effect. Further evidence on the points raised appears desirable. A. W.

978. *Buckling of Thin-walled Cylinders.* R. Lorenz. (Phys. Zeitschr. 12. pp. 241–260, April 1, 1911.)—A thin cylinder, of height long compared with its diam., buckles, under the action of external forces on its ends, in a sine curve according to Euler's strut formula. If the length and diam. are of the same order of magnitude the axis may remain straight and the sides bulge, so that a section through the axis has sine-curve sides, and cross-sections which were plane before buckling become conical. But the axis does not generally remain straight. This asymmetrical buckling has been investigated, but not exhaustively, by Mallock and Timoschenko. The present author investigates the problem of asymmetrical buckling, using Love's theory of thin plates and shells. The mathematical investigation is carried out at considerable length, it being assumed that the axial deformation is small compared with the lateral, and that the walls are thin compared with the diam. Both axial and radial external pressures are investigated, and the problem is solved both on the first and the second approximations of Love's theory. In both cases it is assumed that the square of the thickness of the walls can be neglected in comparison with the square of the radius. The mathematical results are plotted graphically, and, for the case of the cylinder under external pressure, are compared with experimental observations. C. A. M. S.

979. *Tests on Nickel-steel Details for the Board of Engineers, Quebec Bridge.* (Eng. News, 65. pp. 526–531, May 4, 1911.)—The Board of Engineers contemplated the use of nickel-steel in the main members in order to reduce the enormous dead-loads (because the material permits higher stresses). To obtain definite test-figures on the strength of nickel-steel riveting two extensive series of tests were made. The first covered a large number of riveted splices, lap and butt, with different thicknesses of plate packing. The other series was made on models of the principal compression members. Tests were made by A. N. Talbot and H. F. Moore. The results showed that the ultimate strength of nickel-steel joints averaged 15 per cent. higher than joints of ordinary structural steel. Alternating-stress tests were also made. They proved that stress reversal produces marked movements at joints. Tests on columns showed that they failed at loads slightly below the elastic limit of tensile tests. C. A. M. S.

980. *Flexure of Flat Circular Plates within the Elastic Limit.* **P. T. Steinthal.** (Engineering, 91. pp. 677–678, May 26, 1911.)—Describes experiments on flat circular boiler-plates of various thicknesses and diams. when subjected to an evenly distributed load on one side. This was applied hydraulically. Experiments were confined to work within the elastic limit. The original theory of Grashof is mentioned. The experiments show that the actual deflection comes out lower than would have been expected from this theory, and that the greater the ratio of thickness to diam. the greater is the divergence. An explanation of this is given and the invalidity of certain assumptions made by Grashof is shown. C. A. M. S.

981. *Some Causes of Failure in Metals.* **H. Fay.** (Mech. Eng. 27. pp. 690–691, June 2, 1911. Abstract of paper read at the Congress of Technology, 50th Anniversary of Mass. Inst. of Technology.)—Gives illustrations of the value of the application of metallography to ordnance. An interesting example mentioned is that of a gun lever for a 14-in. gun. Microscopic examination showed the presence of a considerable amount of slag. Other cases are quoted to show the importance of such examinations. C. A. M. S.

982. *Resistance to Slipping of Iron embedded in Concrete.* **C. Bach.** (Zeitschr. Vereines Deutsch. Ing. 55. pp. 859–860, May 27, 1911.)—The resistance to slipping of an iron bar embedded in concrete can be determined directly by finding the direct forces necessary to pull or push the iron from the concrete. The stress t_1 per cm.² of surface is $= P/\pi dl$, where $P =$ the force determined as above; d and l are respectively the diam. and embedded length of the iron bar. This equation, as well as experiment, disproves the

common fallacy that the resistance to slipping is proportional to the length. The results of a number of tests are given, the method being to break the specimens in tension to ensure more accurately central loading. A curve is plotted of values of l against t_1, which, for the composition of iron and concrete used, obeys the equation $t_1 = 100e^{-(0{\cdot}2+0{\cdot}4\sqrt{l/d})}$. The general form of the equation is $t_1 = me^{-\phi(ul/f)}$, where m is a constant, u is the perimeter of the cross-section of the iron, and f the cross-sectional area. The quantity "ϕ" depends on the elastic properties of the iron and on the strength of the concrete. Since the latter is so liable to variation, the adequate determination of ϕ is a matter of great difficulty. C. A. M. S.

983. *Breath Figures.* **Rayleigh.** (Nature, 86. pp. 416–417, May 25, 1911.)—The manner in which aqueous vapour condenses upon ordinarily clean surfaces of glass or metal is familiar to all. But if, after cleaning in the usual way till the breath deposits equally, the point of a small blow-pipe flame is passed rapidly over the glass, an altered track is left. This is shown by the fact that when the glass is cold the breath will not deposit on this track in the usual way in small drops which scatter the light, but there takes the form of a thin continuous film. The author attributes this effect to the altered degree of cleanliness, *i.e.*, mainly freedom of grease. It is suggested that the film of grease on glass may not be entirely superficial. E. H. B.

984. *Comparison of Chronometers by Wireless Signals.* **Claude, Ferrié, and Driencourt.** (Comptes Rendus, 152. pp. 1152–1155, May 1, 1911.)—In continuation of previous communications [Abstracts Nos. 641 (1910), 810 (1911)] a description is now given of experiments between Paris and Bizerta at a distance of 1550 km. It was found possible to obtain by coincidences the difference of two instruments to 0·01 sec. It is feared that the method may be interrupted during intense electric storms. C. P. B.

985. *Determination of Continuous Change in Absolute Density of a Substance during Fusion.* **W. J. Lyons.** (Roy. Dublin Soc., Proc. 13. 5. pp. 63–72, May, 1911.)—An apparatus is described which enables the density of a substance at any temperature above or below its fusion-stage to be determined with a high degree of accuracy. It consists of a flat or cylindrical bulb, connected to a capillary tube, which is first calibrated. The bulb is weighed empty, then filled with mercury and warmed, the position of the mercury in the capillary tube at various temperatures being noted. Part of the mercury in the bulb is then replaced with the substance under examination, and the bulb and contents heated through the same range of temperature as before, again noting the position of the mercury in the capillary tube at the various temperatures. From data so obtained the density at any given temperature may be calculated. Results obtained in this way with beeswax, white wax, and a mixture of the two, for temperatures around their melting-points, are given in a table, and also plotted as curves, proving that the process of fusion lasts over a considerable range of temperature, a marked loop in the curves also indicating a considerable "lag" effect between the volumes on cooling and heating during the fusion stage. Thermal expansion of the waxes in the liquid state is quite uniform for the range studied, but below the melting-point the expansion of the solid, which is very much greater than that of the liquid above it, does not follow a linear law. W. H. St.

986. *Determination of the Density of Liquids.* **H. Hartley** and **W. H. Barrett.** (Chem. Soc., Journ. 99. pp. 1072–1074, May, 1911.)—The authors describe the conditions under which a density determination accurate to ± 5 units in the sixth decimal place may be made. A form of pyknometer is described. The weighing of the pyknometer was carried out against a closed counterpoise of nearly the same surface area, made of the same kind of glass.

If—

W_p is the true weight of the empty pyknometer in a vacuum,
W_c is the true weight of the counterpoise in a vacuum,
V_p is the volume of liquid in the pyknometer when filled to the mark,
V_{pg} is the volume of the glass of the pyknometer,
V_c is the external volume of the counterpoise,
W_1 is the apparent weight in air of the empty pyknometer (corrected for air displaced by the brass weights) when weighed against counterpoise,
W_2 is the apparent weight in air of the pyknometer full of water (corrected for air displaced by the brass weights) when weighed against counterpoise,
W_3 is the apparent weight in air of the pyknometer full of liquid (corrected for air displaced by the brass weights) when weighed against counterpoise,

Δ_1, Δ_2, Δ_3 are the densities of air at these successive weighings, δ_w is the density of water, and δ_l is the density of liquid at the temperature of the experiment referred to water at 4°.

Then—

$$\delta_l = \delta_w \frac{W_3 - W_1 + \Delta_1(V_c - V_{pg})}{W_2 - W_1 + \Delta_1(V_c - V_{pg})},$$

provided—

$$V_c = V_{pg} + V_p, \qquad W_1 = W_p - W_c + \Delta_1(V_c - V_{pg}),$$
$$W_2 = W_p + \delta_w V_p - W_c, \qquad W_3 = W_p + \delta_l V_p - W_c.$$

Experimental numbers are given for the density of solutions of potassium chlorate and of potassium chloride. A. F.

987. *Weight of a Falling Drop and the Laws of Tate.* IV. *Standardisation of a Tip; and the Calculation of the Surface Tension and Molecular Weight of a Liquid from the Weight of its Falling Drop.* **J. L. R. Morgan.** (Amer. Chem. Soc., Journ. 33. pp. 643–657, May, 1911. Contribution from the Havemeyer Lab. of Columbia Univ., No. 186.)—[See Abstract No. 854 (1911).] The author puts forward his method of standardising the tip, *i.e.*, for finding the normal molecular temperature coefficient, k, of all the non-associated liquids falling from it, which is based solely on the equation $w(M/d)^{2/3} = k(t_c - t - 6)$. Benzene, with a critical temperature of 288·5°, was taken as standard liquid. It is also shown that the surface tension, in degrees, of any liquid at any temperature, can be calculated from its drop weight in mgm. from any tip at that temperature, by multiplying the latter by the ratio of the k value of surface tension to the k value for that tip, both being found by use of benzene as the standard. Any liquid which, with this normal value of k gives the same calculated value of t_c, within the limits of error, at all the temperatures of observation, is then to be regarded as a normal, non-associated liquid, for this proves that the normal k is also the proper and correct change per degree of its molecular function. This value of t_c calculated, need not always agree with the observed value of the critical temperature, which would indicate that while some liquids are in corresponding states when equally removed from their critical temperatures, others are so only when equally removed from another, fictitious one. From this point of view, it is shown that aniline, pyridine, and quinoline are perfectly normal in molecular weight, even from the results of capillary rise, although the customary method of calculating k shows the first two to be associated, and the latter dissociated. This confirms the results of drop weight. It is shown, finally, that the application to drop weights of the empirical formula for the calculation of t_c without a knowledge of the molecular weight, as given by Walden, leads to results which differ but slightly from those calculated by the aid of the normal constant k. [See next Abstract.] A. F.

988. *Weight of a Falling Drop and the Laws of Tate.* V. and VI. *Drop Weights of Non-associated Liquids.* **J. L. R. Morgan, E. G. Thomssen,** and **G. H. Daghlian.** (Amer. Chem. Soc., Journ. 33. pp. 657–672, and pp. 672–684, May, 1911. Contributions from the Havemeyer Lab. of Columbia Univ., Nos. 187 and 188.)—V. From drop-weight results it is shown that, using the new criterion of normal molecular weight, viz., the finding of a value t_c, using the normal (benzene) value of k_B, in the equation—

$$w\,(M/d)^{2/3} = k_B\,(t_c - t - 6),$$

which is constant, independent of the temperature of observation, is fulfilled for ether, ethyl-n-butyrate, anisole, phenetole, ethylene dibromide, chloroform, benzonitrile, and carbon disulphide. These liquids are therefore (according to the criterion adopted) non-associated. The same conclusion can be reached from the results of capillary rise, provided we assume in that method the presence of a not excessive variable error. Only in the cases of ether and chloroform do the values of t_c as calculated, agree closely with the observed critical temperatures, but the fictitious values of the critical temperature found for the others agree with those that are calculated from the capillary rise. It is shown that the calculated t_c for a mixture of benzene and carbon tetrachloride 1 : 1 by weight, is practically the mean of the values found for these two liquids alone. VI. The following liquids are to be regarded as perfectly non-associated as is benzene itself : bromobenzene, bromine, ethylidene chloride, toluene, phosphorus trichloride, *p*-, *o*-, and *m*-xylene, mesitylene, ethylbenzene, iodobenzene, fluorobenzene, cymene, ethylene chloride, methyl aniline, ethyl aniline, isobutyl acetate, carbon disulphide, and diphenylmethane. In the case of dimethyl aniline the discrepancy in the values of t_c is 0·8 per cent., which is much too great for an experimental error, and can show that the molecular weight is only slightly abnormal, which may well be due to the fact that this liquid is very readily decomposed. Of the value of t_c calculated for the above liquids, those for bromobenzene, bromine, ethylidene chloride, toluene, phosphorus trichloride, *o*-, *m*-, and *p*-xylene agree excellently with the observed values of critical temperature, while the disagreement with this value is below 1 per cent. for mesitylene, and but slightly above that for ethylbenzene and iodobenzene. The agreement between the calculated values of t_c from drop weight and those from capillary rise, with the eleven liquids which have been studied by that method, is exceedingly good for toluene and phosphorus trichloride. In the other cases the mean of the t_c value from capillary rise agrees well with that for drop weight; and it is only for mesitylene and *m*-xylene that the values in mean from capillary rise disagree with those from drop weight. In the case of the latter liquid, however, this seems to mean little, as the values by two observers, although higher throughout, do not agree even fairly with one another. A. F.

989. *Harmonic Analysis Diagrams.* **R. Beattie.** (Electrician, 67. pp. 826–828, June 9, and pp. 870–872, June 16, 1911.)—In Fourier analysis the equation to a periodic curve is obtained in the form—

$$y = A_0 + \Sigma A_n \sin nx + \Sigma B_n \cos nx.$$

The ordinary approximate methods are based on the equations—

$$A_0 = \frac{1}{m}(y_1 + y_2 + \ldots + y_m), \quad A_n = \frac{2}{m}(y_1 \sin nx_1 + y_2 \sin nx_2 + \ldots + y_m \sin nx_m)$$

and a similar equation for B_n. When $y_1, y_2 \ldots y_m$ are known, the labour involved in computing the coefficients consists mainly in calculating the products $y_1 \sin nx_1$, &c. The author obviates this labour by constructing reciprocal sine and reciprocal cosine scales. By drawing the curve to be analysed on tracing paper and placing it over these scales the products $y_1 \sin nx_1$, &c., are found directly from the scales and the constants A_n and B_n can then be found by simple addition. Any ordinary scale will give A_0. Assuming that diagrams of these scales having 12 ordinates, for instance, are constructed the author shows how high harmonics such as the 23rd can be found by their use. By taking four readings at equal distances apart and then taking the mean a result is obtained taking into account 48 ordinates. In conclusion the author describes modified diagrams suitable when y is not given as a continuous curve but only its values at equal distances apart. A method utilising a planimeter is also given. A. R.

990. *Transformation of Space-time Co-ordinates from Quiet to Moving Systems.* **P. Frank** and **H. Rothe.** (Ann. d. Physik, 34. 5. pp. 825–855, May 9, 1911.)—A mathematical paper which reaches the following conclusions. (1) There are three types of transformations, in each of which the contraction is independent of the direction of motion in absolute space. (2) In the Lorentz transformation the speed of light in any direction has the same value *c* in all moving systems. (3) In the Doppler transformation this is only true for propagation in one direction. (4) For the Galileo transformation it would be generally true only if the speed of light were infinite. [See Abstract No. 790 (1910).] E. H. B.

991. *Solar Radiation, Atmospheric Absorption, and Sky Polarisation at Washington, D.C.* **H. H. Kimball.** (Mount Weather Observatory, Bull. 3. 2. pp. 69–117, 1910.)—A continuation of previous work [see Abstract No. 658 (1910)]. The conclusions arrived at are summarised by the author as follows: (1) The pyrheliometers employed in measuring solar radiation intensities should be frequently compared with a sub-standard; an international standard should be maintained for the intercomparison of the sub-standards of the different meteorological services and central observatories. (2) The max. observed intensity of solar radiation at Washington at the ground, 1·44 cals. per min. per cm.^{2} of normal surface, occurred in April, and the maximum for Dec., 1·32 cals., is only 8 per cent. less. The greatest

monthly noon average, 1·28, was obtained in Feb., and the Dec. average, 1·15, is only 10 per cent. less. The greatest daily total of radiation received on a normal surface, 971 cals., was obtained in July, the corresponding Dec. total being 60 per cent. as great. The greatest daily total for a horizontal surface, 658 cals., was also obtained in July, and the corresponding total for Dec. is only 30 per cent. as great. (3) The totals recorded by a Callendar horizontal pyrheliometer are very considerably in excess of the totals obtained from the Ångström, the differences varying with the atmospheric conditions. (4) Variations in the percentage of sky polarisation aside from the diurnal variation are closely related to changes in the general atmospheric absorption. (5) A modified form of the Ångström equation enables us to compute the value of the solar constant from pyrheliometric determinations of the radiation and psychrometric determinations of the aqueous vapour-content of the atmosphere, with a probable error of less than 3 per cent., provided we confine ourselves to observations obtained on cloudless days on which the polarisation indicated that the atmospheric transmissibility was not changing. (6) There is evidence that the so-called solar constant is a variable quantity. (7) There is stronger evidence that the atmospheric transmissibility undergoes marked changes that are nearly synchronous over considerable portions of at least a hemisphere, and that diminished transmissibility is accompanied by a diminution in temperatures and in temperature amplitudes. (8) Marked diminutions in atmospheric transmissibility occurred in 1884–86, and in 1903 to 1904, that were undoubtedly connected with violent volcanic eruptions. Less marked diminutions in transmissibility occurred in 1891 and 1907 that have not yet been connected with phenomena of this nature. (9) These fluctuations do not coincide with variations in sun-spot numbers or in solar prominence frequency. L. H. W.

992. *Causes of Variation in the Polarisation of Sky Light.* **H. H. Kimball.** (Frank. Inst., Journ. 171. pp. 333–344, April, 1911. Paper read before the Phil. Soc., Washington, Feb. 25, 1911.)—From the data given in the paper it appears that while the polarisation of sky light is greatly modified by reflection from the surface of the earth, it is intimately connected with meteorological processes and conditions. Decreased polarisation may be produced by mechanical haze, due to the presence of large particles of any description in the atmosphere, or by optical haze, due to a lack of homogeneity in the atmospheric layers. L. H. W.

993. *Vertical Temperature Distribution in the Atmosphere over England.* **W. H. Dines.** (Roy. Soc., Phil. Trans. 211. pp. 253–278, June 12, 1911.)—The paper discusses the results obtained by means of registering balloons during the three years 1908, 1909, 1910. Out of 400 balloons liberated rather over 250 have been recovered and have given satisfactory traces. Tables are first given showing for each month the mean temperature for each km. from ground level to 14 km. In Table II. the raw values are corrected for the variation of pressure at ground-level, and in Table III. the values are further smoothed by using them to determine the first term of the Fourier series of the annual variation, and adopting the values that it gives. The results show that the temperature decreases steadily up to a height of 10 or 11 km., and remains almost stationary above that height. The annual range decreases from the surface up to 2 or 3 km.; it then continues nearly constant with perhaps a small increase at 7 or 8 km. up to about 11 km., at which height it is abruptly reduced to less than half its former value. In the strata above

1 or 2 km. the max. and minimum values are delayed for about a month, but above the point at which the vertical temperature gradient ceases they come back and occur at the summer and winter solstices. The information regarding diurnal temperature-variation in the upper atmosphere is as yet very meagre. On two occasions balloons were sent up from Manchester University at handy intervals over a period of more than 24 hours. Neither series shows anything in the higher strata resembling the ordinary daily change of temperature at the surface. On one occasion temperature began to rise 8 hours before sunrise and a minimum occurred at noon. A comparison between records obtained at sunset and at 8 a.m. on the following morning shows that in winter the temperature above was slightly lower, about 2° C., in the morning than at sunset, whereas in summer the morning values were higher by about 2° or 8°, but it is not possible to say whether this difference is due to solar radiation or to a real change in the air. A very close relation undoubtedly exists between the temperature of the upper air and the height of the barometer at sea-level, and to exhibit this a table is given showing the result of grouping the observations according to sea-level pressures. The table shows that the lower strata are cold in a cyclone and warm in an anticyclone, and that this is reversed up above. At 10 km. the intermediate type of weather has the lowest temperatures. The temperature gradient ceases at 8 km. in the cyclone, but not till 12 km. in the anticyclone. These results confirm those obtained by other investigators from continental data. Consideration is next devoted to the annual variation of H_c, the height at which the vertical temperature gradient ceases, or where the so-called "isothermal" begins and T_c the temperature in this region. The uncorrected values of H_c are first given, then similar values corrected for variations of pressure at sea-level. May and Sept. appear to be exceptional months, but the number of observations is small. Finally, smoothed values are obtained by expressing the results by means of a sine curve with an annual period. These values show a minimum at 10·5 km. in March and a maximum at 11·6 km. in Aug. and Sept. It appears that the relation between H_c and the height of the barometer may be taken as practically a linear one if a correction is applied for the annual variation, low values of H_c occurring at times of low barometer. The value of H_c appears to be subject to great variations over short distances and in short intervals of time. The values of T_c are closely connected with those of H_c. If allowance be made for annual variation we find for $H_c = 8{\cdot}4$ km., $T_c = 224{\cdot}5$°A., while for $H_c = 12{\cdot}3$ km., $T_c = 218$° A. The average height attained by a balloon is greater in summer than in winter. The surface wind in England is certainly stronger in winter than in summer, but the distances travelled by the balloon before coming back to earth are rather greater in summer than in winter. The shortest runs have been obtained under conditions of low barometer—a fact which does not favour the view that cyclones are caused by strong winds in the upper atmosphere. With reference to the bearing of the place of fall, no definite statement can be made. Balloons seldom come to earth due west, but SW. and NW. are quite common directions. The track of the balloon in general follows an isobar fairly closely, but the track cannot be foretold with certainty from a knowledge of the distribution of pressure. In the second part of the paper the results obtained have been used to construct a diagram showing the average distribution of pressure and temperature over a vertical section extending from the centre of a cyclone to that of an anticyclone. In the lower strata, near the centre of a cyclone, the temperature is below the mean for the appropriate level, while in regions of high pressure the reverse

is true. If we regard a region in the free atmosphere in which the temperature is below the average as one in which the air is or has recently been ascending and *vice versâ*, then the diagrams suggest that there is an ascending current in the cyclone, starting from close to the ground and reaching up to the isothermal. As the height from the ground increases the current is extended over a larger area, so that roughly it forms the frustum of a cone with its apex downwards. The descending current of the anticyclone starts from a height of about 11 km., and also spreads out as it descends; it too forms part of a cone, but the apex is pointed upwards. The descending current rarely if ever reaches the surface in the anticyclone. In many winter anticyclones we find a persistent layer of lower cloud, with great dryness above it; clearly the descending air cannot penetrate this layer of cloud, for if it did so the cloud would immediately be dispersed. The concluding paragraphs of the paper are devoted to the consideration of the causes of this distribution of temperature in cyclones and anticyclones. R. G. K. L.

994. *Solar Eclipse of April* 28, 1911. **C. W. Raffety.** (Nature, 86. p. 554, June 22, 1911.)—The observers who went to Vavan were unsuccessful, but perfect conditions were experienced on the islands some distance away and good results obtained. C. L. Wragge saw the eclipse from the island of Monngaone in the Tongan group. Four large streams of the corona were noted, and shadow bands were very prominent. The streamers of the corona were in pairs, two extending NE. and two SW., while silver-white ridges of the inner corona extended round the NW. quadrant. Some photographs were secured, but were taken to New Zealand for development. C. P. B.

995. *Changes on Jupiter.* **O. Lohse.** (Publikat. des Astrophys. Observat. zu Potsdam, Vol. 21. No. 62. Nature, 86. p. 564, June 22, 1911. Abstract.)—This volume contains a full account of the observations of Jupiter at Potsdam during the period 1881–1909. The equatorial diam., measured with a filar micrometer, was 38·343″, and the polar diam. 36·081″. The polar compression is 1 : 16·584. Twelve plates are included in illustration of the discussion. C. P. B.

996. *Physical Observations of Mars.* **R. Jarry-Desloges.** (Comptes Rendus, 152. pp. 1142–1144, May 1, 1911.)—Summing up the general results from observations made at the three stations of Revard, Massegros, and Toury [see Abstracts Nos. 2009 (1909), 234 (1910)] it is remarked that one of the chief points noticed was the regularity with which the south polar cap diminished and disappeared. On the contrary the changes noted in the form of the dark markings did not exhibit any definite regularity. The various discolourations which have been seen from time to time are at present inexplicable. A few remarks are given describing the interference of terrestrial air-currents on the definition of celestial objects seen through the disturbed air strata. C. P. B.

997. *Spectrum of Nova Lacertæ.* **W. H. Wright.** (Lick Observatory Bulletin, No, 194. Nature, 86. pp. 393–394, May 18, 1911. Abstract.)—Photographs of the spectrum of this interesting new star in Jan., 1911, with spectrographs on the 36-in. and 12-in. refractors. Certain coincidences with the bands of nitrogen shown in the comparison spectrum are very suggestive, but the similarity may be accidental. Spectra obtained on March 30 show that the Nova had then changed into a nebula, bands being recorded near λλ4861, 4959, 5007, 5752, 6563. C. P. B.

998. *Altitude of Aurora Borealis.* **C. Störmer.** (Comptes Rendus, 152. pp. 1194–1196, May 1, 1911.)—A preceding note [Abstract No. 1088 (1910)] gave the preliminary observations of the aurora made at Bosekop during Feb. and March, 1910. The present note gives the results of a series of photographic determinations of the altitude of the aurora. Exposures were from 1 to 20 sec. duration, showing observed phenomena from 40 to 870 km. C. P. B.

REFERENCES.

999. *On Mirror Reading with Multiple Reflections.* **W. Volkmann.** (Phys. Zeitschr. 12. pp. 183–184, March 1, and pp. 223–224, March 15, 1911.)—A description of the various methods which may be adopted for the measurement of small angular displacements, amongst which is mentioned that described by W. P. White [see Abstract No. 181 (1905)]. W. C. S. P.

1000. *Marine Microthermograms and Influence of Icebergs on the Temperature of the Sea.* **H. T. Barnes.** (Nature, 85. pp. 137–138, Dec. 1, 1910.)—The author shows by means of sea-temperature curves that his electrical microthermometer is capable of announcing the presence of an iceberg from observations of the temperature gradient. L. H. W.

1001. *Tidal Forces.* **C. Braak.** (Konink. Akad. Wetensch. Amsterdam, Proc. 13. pp. 1231–1236, May 26, 1911.)—The paper contains a discussion of a series of determinations of tidal forces measured by Wiechert's astatic seismograph at Batavia. It is concluded that for such work the instrument is very well suited, for both the diurnal and semi-diurnal tides. C. P. B.

1002. *Calcium Lines in Spectrum of Solar Disc.* **W. H. Julius.** (Konink. Akad. Wetensch. Amsterdam, Proc. 13. pp. 1263–1273, May 26, 1911.)—The author discusses the varying appearances of the H and K lines of calcium as shown at different points of the solar disc from the standpoint of their being produced by various degrees of anomalous refraction. C. P. B.

1003. *Apex of the Sun's Way.* **A. Wilkens.** (Astronom. Nachr. No. 4499. Nature, 86. p. 495, June 8, 1911. Abstract.)—Deduced from 620 stars having large proper motions, the value of the solar apex is given as RA = 286°; Decl. = +37°. C. P. B.

1004. *Early Visibility of New Moon.* **C. T. Whitmell.** (The Observatory, No. 435. p. 203, May, 1911. Nature, 86. p. 460, June 1, 1911. Abstract.)—Discussing an observation of the new moon when only 16 hours old, on Feb. 10, 1910. Difference in azimuth between sun and moon only 10°, and altitude only 4° or 5°. C. P. B.

1005. *Pressure in Stellar Atmospheres.* **C. P. Butler.** (Nature, 86. pp. 362–363, May 11, 1911.)—Discusses recent work in astronomical spectroscopy, in particular that of Hale and Adams.

1006. *Nova Sagittarii No. 4.* **Miss Cannon.** (Harvard College Observatory Circular, 164, 1911. Nature, 86. p. 495, June 8, 1911. Abstract.)—This Nova was detected by the author in the course of an examination of photographs constituting Map 48 of the "Harvard Sky." It is shown on eleven plates taken between May 22 and July 9, 1901, but is absent from others taken during the interval 1892–1899, or from 1900–1910. At its maximum the Nova was about 9·7 magnitude. C. P. B.

LIGHT.

1007. *Action of a Prism on Light.* **G. Green.** (Roy. Soc., Edinburgh, Proc. 81. pp. 290–295, 1910–1911.)—The *modus operandi* of a prism has been dealt with by Schuster in his explanation of Talbot's bands by consideration of group-velocities [Abstract No. 746 (1904)]. In a paper by Ames on the action of a prism on white light [Abstract No. 86 (1906)] a view similar to that of Schuster is adopted. The theory given in these papers, together with the earlier work by Gouy and by Rayleigh, is now regarded as complete, but it is difficult to form from it a general impression regarding the wave-system produced by a prism from a given impulse; and as this may be useful, the object of the present note is to illustrate the action of the prism by associating it with a definite wave-pattern. Consider the case of an incident light-pulse when first it meets the side of the prism. The pulse travels along the face of the prism with uniform velocity, and the problem is to determine the wave-system which it originates, and to follow the configuration of each group of waves characterised by a given wave-length after emergence. The wave-system within the prism can be determined directly by means of Fourier's theorem, provided the wave-velocity of all the wave-trains, into which the original disturbance can be analysed, is known; or more conveniently perhaps by the principle of stationary phase as applied by Havelock in his paper on the propagation of groups of waves in dispersive media. The corresponding problem in hydrodynamics is to determine the wave system arising from the application of a point-pressure which moves with constant velocity over the water surface. In each case the disturbance can be determined by the consideration of wave-trains whose velocity varies with the wave-length, and we can therefore take the ship-waves pattern to illustrate the main features of light-propagation through the prism. In this way a general idea of the whole wave-system is obtained, and an explanation is also given as to why Talbot's and Powell's bands are obtained only when the retarding plate is inserted from the thin side of the prism. A. W.

1008. *Anomalous Dispersion of Light in Gases.* **W. H. Julius** and **B. J. van der Plaats.** (Konink. Akad. Wetensch. Amsterdam, Proc. 18. pp. 1088–1098, April 20, 1911.)—The authors claim that as a consequence of the acceptance of the dispersion theory of absorption, every absorption line must involve anomalous dispersion of neighbouring waves; and they give a discussion of the conditions for a number of gases and vapours, including iodine, bromine, and nitrogen peroxide. Illustrations are given showing the shift of interference bands from light which has been subject to absorption in the various vapours. It is concluded that selective absorption is always accompanied by anomalous dispersion. C. P. B.

1009. *Interference Fringes of a Linear Source.* **C. Raveau.** (Comptes Rendus, 152. pp. 1155–1158, May 1, 1911.)—[See Abstract No. 2087 (1901).] Let AA′ be a finite straight line along the centre of a luminous pencil. A ray along AA′ is divided by an interference apparatus such as Jamin's mirrors into two rays, I. and II., lying, after emergence, along the lines CC′, DD′. Let a linear luminous source, AS, normal to AA′ and bisected by it, be displaced along AA′, revolving meanwhile about it.

The resulting fringes produced at different points of CC′, in planes of observation approximately normal to CC′ are here investigated. There is distinct visibility at points of interference of rays from the point A originally normal to AS. The rays II. satisfying the last condition form sensibly a paraboloid containing DD′, and having as its second system of generators lines perpendicular to DD′. This paraboloid is cut in two points by CC′. Thus on each emergent ray there are two points of perfect visibility. The direction of the fringes at one of these points on CC′ is shown to be normal to the perpendicular from the other point to the conjugate ray DD′. Besides those on CC′ there are other points of perfect visibility lying on the curve of intersection of the paraboloid formed by rays II. with the paraboloid formed by rays I. In the neighbourhood of C this curve lies approximately in the tangent plane to paraboloid (II.). Hence the deduction: Besides the point of perfect visibility there is in general, in the plane of observation only one line of optimum visibility, and this line is, for each of the two points of visibility relative to the same point source, approximately normal to the fringe through the other point. The set of rays proceeding from a line source AS to form a fringe C′F′, has for section at C a line, or narrow band, along CF. It is shown that a portion of the light will escape interference unless C′ be chosen so that the two conjugate fringes CF, C′F′ are at right angles. When C′ is so chosen, a slit A′S′, at right angles to the linear source AS, will allow only useful light to pass. A. E.

1010. *Neutral-tinted Absorbing Screen for Photometry.* **H. E. Ives** and **M. Luckiesh.** (Phys. Rev. 32. pp. 522–529, May, 1911.)—Ordinary "neutral tint" and smoked glasses are not really neutral, but exhibit selective absorption when tested spectrophotometrically. They cannot therefore be used in accurate colour-photometry, and there is a need for some neutral method of dimming the incident light in cases in which the ordinary photometric methods cannot be used. The flicker rotating sector disc has merits, but cannot be applied with the flicker photometer, as it gives rise to stroboscopic bands. In some experiments of this kind the authors therefore devised a form of neutral screen consisting in an opaque line grating on glass. With a fine ruling the ratio of obscurity to clear glass, on which the absorbing power depends, may be as much as 4:1; with coarse ruling (*e.g.*, 40 or less lines to the inch) even higher. The authors then discuss mathematically the magnitude of possible errors and show that they can be reduced to within the limits of accurate photometry. The method is not of service when bright filaments, &c., are viewed and projected, but is regarded as useful when the light is received on a diffusing surface and strictly neutral properties as regards colour are required. J. S. D.

1011. *Visibility of Radiation Recalculated.* **P. G. Nutting.** Bureau of Standards, Bull., 7. pp. 235–238, May, 1911.)—The author has previously deduced, using Koenig's data on the subject, the visibility (*i.e.*, the relative luminous effect produced by a certain energy) throughout the spectrum. He now finds that a correction is necessary owing to the effect of Koenig's prismatic dispersion curve not having been allowed for previously. The effect of this is to alter substantially the positions of the maxima of the visibility curves at high and low illuminations; these should now be situated at 0·544 μ and 0·508 μ respectively, and they may now be assumed to be the qualities of light to which the eye is most sensitive, for strong and extremely weak light. J. S. D.

1012. *The Origin of "White" on the Lumière Autochrome Plate.* **A. Forster.** (Zeitschr. Wiss. Phot. 9. pp. 291–301, April, 1911.)—When an unexposed plate is fixed, the colour of the transmitted light is a reddish grey and not pure white, yet when a plate has been exposed to the action of white light and then developed, &c., a pure white image is obtained. The usual explanation given of this is that it is contrast effect. An experiment is described to test this point and as the result of it, the conclusion is arrived at, that the white obtained in autochrome photographs cannot be explained as a contrast phenomenon. The photometric investigation of the coefficient of transmission for white light shows, that in spite of the much clearer appearance of the "white" places than that of the unaltered colour screen, their transparency for white light is essentially smaller. This points to the effect being due to an objective alteration of the silver bromide in the sensitive film. The microscopic examination with a magnification of 300–500 diams. shows that in a *white* place of the image there exists on the coloured starch grains a fine granulation of separated blackened silver, and it is concluded that this appearance explains the fine white effects obtained. A. E. G.

1013. *The Photographic Plate.* **W. D. Bancroft.** (Journ. Phys. Chem. 15. pp. 313–366, April, 1911.)—What is the nature of the change which produces the latent image? The latent image is more readily attacked by HNO_3, &c., than the unaltered AgBr is; but is less soluble in sodium thiosulphate. It destroys itself by photo-retrogression (Baekeland, Internat. Kong. f. angew. Chem. 1903), the reaction being reversible. The retrogression is most readily observable in under-exposed bromide prints or films, and is favoured by warmth, humidity, acidity, KI in the emulsion. Formation of the latent image presents a period of inertia; the effect of exposure shorter than this is speedily undone (Brush). A fine grain of emulsion favours retrogression (Lüppo-Cramer). Other causes of production of latent image are: traces of $SnCl_2$ (Namias), pressure (Carey Lea), heat with traces of moisture (Carey Lea), cold dilute sulphuric acid (Carey Lea), thiocarbamide (Waterhouse process). The chief theories of the latent image are: it is an oxidation product; a physical modification; a silver nucleus; a sub-bromide; a solid solution. The oxidation product theory (v. Tugolessow, Phot. Correspondenz, 1908); formation of latent image under light is promoted by oxidising agents; oxidation-products break up, forming sub-compounds of silver: experiments on fresh AgCl, AgBr, AgI, of which the last was the most sensitive to light. The physical modification theory (Chapman Jones, *vide* Perley, Journ. Phys. Chem. 1910); allotropic modification fairly stable and the quantity of it not vanishingly small; ammonia does not reduce the quantity of it and eat away the nuclei left, as it would with Ag_2Br. Namias supports this theory; no other is possible in the daguerrotype; and why should development penetrate the film and not equally travel laterally? He assumes that light polymerises AgBr; Hurter and Driffield believed that light depolymerised Ag_nBr_m, rendering it more easily attacked by the developer; they showed that no Br at all is liberated on exposure; and the difference between exposed and unexposed bromide in development is one of degree only, not of kind. *Contra* (Bolhamley) if Ag_2Br be formed, the Br liberated will be combined with the gelatine, not set free to escape. Hurter and Driffield pointed out, however, that the energy of the light impinging was not sufficient to account for the chemical change. The appearance of a visible change denotes that there will be solarisation reversal on development. [See Abstracts Nos. 84 (1906) and 222 (1911).] A. D.

1014. *Modification in the Sulphide Toning of Bromide Prints.* **W. F. A. Ermen** and **C. W. Gamble.** (Soc. Chem. Ind., Journ. 30. pp. 657-659, June 15, 1911. Paper read before the Manchester Section, May, 1910.)—One of the most successful methods of modifying the tints of silver bromide prints is to convert the black silver deposit to one of brown colour, by what is known as "Sulphur toning," which consists in treating the print with a solution of iodine in potassium iodide, in order to change the image to silver iodide. It is then washed, treated with sodium bisulphite to decompose the starch iodine compound, again washed, and then immersed in dilute ammonium sulphide. The image turns brown, and the quality and colour of the brown is largely determined by the physical and chemical condition of the original print. There are many factors which determine this condition, and amongst the more important are the original sensitive surface, the negative, the exposure, the developing agent used, and the amount of deposit produced by development. A number of prints on the same brand of bromide paper, and developed respectively with ferrous oxalate, metol-quinol, and amidol, are treated with the following reagents to convert the metallic silver image into silver halide: (1) Chlorine, bromine, and iodine. (2) Potassium ferricyanide and a soluble bromide. (3) Potassium dichromate and hydrochloric acid. (4) Cupric chloride and bromide. (5) Lead ferricyanide. (6) Mercuric chloride. The results obtained after the prints have been subsequently treated, in each of the above cases, to yield images of silver sulphide, are discussed. A. E. G.

1015. *Influence of Temperature and Magnetisation on Selective Absorption and Fluorescence Spectra.* II. **H. du Bois** and **G. J. Elias.** (Deutsch. Phys. Gesell., Verh. 13. 8. pp. 345-352, April 30, 1911.)—The measurements of the previous paper were confirmed and extended, and the collected results are given. These deal chiefly with the absorption and fluorescence bands of ruby; a table shows the displacement of the red bands from 692·5 $\mu\mu$ at −190° C. to 703·7 $\mu\mu$ at 345° C. The effect of magnetisation was measured by means of a large half-ring electromagnet with pole immersion in liquid air, a field of about 50 kilogauss being employed. The Cotton-König effect was reproduced by means of two rubies. [See also Abstracts Nos. 1425 (1908) and 46 (1911).] G. E. A.

1016. *Absorption Spectrum of Solutions of Neodymium Chloride.* **G. P. Baxter** and **T. S. Woodward.** (Amer. Chem. Soc., Journ. 33. pp. 270-272, March, 1911.)—In a recent paper upon the atomic weight of neodymium [Ibid. 33. p. 18] the absorption spectrum of aqueous solutions of neodymium salts from λ7000 to λ4000 is described. The present paper deals with the ultra-violet absorption spectrum, a large quartz spectrograph being used for the measurements. A table of the position and characteristics of each band is given, many not previously observed being shown; these new bands range from λ3288 to λ2913, are nearly all weak and can only be observed under the most favourable conditions. The numerical agreement for the other bands with the measurements of Holmberg and of Jones and Anderson is very satisfactory. A. W.

1017. *Absorption Spectra of Permanganates in Certain Solvents.* **T. R. Merton.** (Chem. Soc., Journ. 99. pp. 637-639, April, 1911.)—The spectra of the permanganates do not appear to be influenced by the nature of the metallic radical nor the extent of ionisation, but the nature of the solvent has a considerable effect on the position of the three absorption bands. The approximate positions are as follows:—

Water	5719	5478	5255
Methyl acetate	5720	5479	5258
Acetic anhydride	5719	5480	5260
Acetonitrile	5719	5477	5257
Ethylene glycol	5730	5484	5267
Acetone	5736	5494	5275
Pyridine	5735	5492	5275
Methyl alcohol	5747	5505	5282
Ethyl alcohol	5747	5503	5282

A solid solution in potassium perchlorate gave—

	5577	5345	5135

values which differ very widely from those of the liquid solutions. T.M.L.

1018. *Air Spectrum.* **G. A. Hemsalech.** (Comptes Rendus, 152. pp. 1007–1009, April 10, 1911.)—By inserting self-induction in the discharge circuit of a condenser, the air-lines in the spark spectrum can be completely eliminated. It is shown in the present paper that in proportion as the air lines disappear with increase of the self-induction, another spectrum of lines appears, becomes preponderant, and finally, with a certain value of the self-induction, alone remains with the negative bands of nitrogen. The most marked lines of this spectrum are found in the red portion of the spectrum, in the neighbourhood of the red hydrogen line, which is itself included in this spectrum. This spectrum emitted by the oscillations the author calls the second air-line spectrum. It is particularly brilliant with large capacities and relatively small self-inductions (from 0·001 to 0·004 henry). With feebly volatile electrodes, such as copper or silver, the lines are well marked, though with iron, or other volatile metals, the second spectrum is feeble or even absent, as the oscillation current is then carried almost entirely by the metallic vapour. A table of the principal lines is given, the observations being made with a single-prism Rutherford spectrograph. The lines 4148·8 and 4151·9 seem to be identical with the new lines discovered by Moissan and Deslandres (Ibid. 126. p. 1689, 1898) in air at low pressure. A. W.

1019. *Spark Spectrum in Magnetic Field.* **G. A. Hemsalech.** (Comptes Rendus, 152. pp. 1086–1089, April 24, 1911.)—The author has previously [Abstract No. 845 (1911)] established the existence of three spectral phenomena observed when a spark takes place in a magnetic field, and has indicated the methods of observing these effects. The present paper deals with the third phenomenon, the "transversal effect." Using electrodes of metallic calcium between the poles of an electromagnet, and allowing the sparks to take place perpendicularly to the lines of force, sparks were obtained of a unique character, rich in metallic vapour. The spark-length was about 5 mm., and was produced with the help of a condenser of 0·04 mfd., the discharge circuit having a self-induction of from 0·012 to 0·05 henry. Interesting results were obtained when the spark took place in an atmosphere of hydrogen. The spectrum thus obtained approximates to that observed in the upper layers of the sun's chromosphere. [See also Abstract No. 1232 (1910).] A. W.

1020. *Influence of the Magnetic Field on the Doppler-effect of Canal Rays.* **H. Baerwald.** (Ann. d. Physik, 34. 5. pp. 883–906, May 9, 1911.)—Researches on the nature of the carriers in the case of spectrum series have up to the present given no absolutely certain results. Stark has arrived at the conclusion that the carriers in the line spectra, including the primary series, are positively charged atoms, while Lenard's results seem to show that the carriers in the secondary series are positively charged; the carriers in the primary series, on the other hand, being neutral particles. Wien has further found that the light emitted by the canal rays in hydrogen is brought about by neutral particles [see Abstracts Nos. 2100, 2101 (1909), and 119 (1911)]. By an examination of the influence of the magnetic field upon the magnitude of the ratio between "moving" and "rest" intensity, it is now concluded that the carriers for the series cannot be positive particles. From the results obtained nothing definite can be stated as to the part played by the positive particles. These results, however, make it appear highly probable that the carriers for the series are neutral particles.

A. E. G.

1021. *Photographic Action of Latex of* Euphorbia peplus. **H. G. Chapman** and **J. M. Petrie.** (Nature, 86. pp. 517–518, June 15, 1911.)—*Euphorbia peplus* is a spurge naturalised in Australia, its latex, or milky juice, being reported as possessing properties of surgical importance. The authors, while examining this latex, exposed near its stain on glass a highly sensitive photographic plate for two days in the dark. A sharply defined image of this stain or trace was produced on development of the plate. This effect on the photographic plate occurred when thick black paper was interposed, or celluloid or paraffined paper. Screens of Al-foil 0·002 mm. thick had no effect; eight layers of the foil increased the density of the image on the plate. A rapid current of dry air passing between the stain and the plate failed to prevent the formation of the image. E. H. B.

1022. *Recent Advances in Fluorescence and Phosphorescence.* **E. L. Nichols.** (Science, 33. pp. 696–700, May 5, 1911. Abstract of paper read before the Amer. Assoc. for Advancement of Science, at Minneapolis.)—A review of recent researches, including the author's own. The relation of the narrow fluorescence bands of the uranyl salts to the broad bands in the fluorescence spectra of other solids and liquids is not at first sight obvious. They appear to be intermediate between the broad bands usual to solids, of which sometimes only one exists, and the complicated groups of lines observed in the case of vapours. Recent studies by the author and Merritt show, however, that the curve for the relation between wave-length and intensity of the seven strongest bands in the fluorescence spectrum of such a salt has a form essentially identical with that of the typical curve for the distribution of energy in the broad single bands of ordinary fluorescence spectra. The shape is the same for the various uranyl salts, being shifted slightly in wave-length with the chemical composition or with the amount of water of crystallisation. That these various bands are due to the oscillations of one and the same complex mechanism may be almost conclusively established by observing the spectrum under various conditions of excitation and of temperature. When the substance is gradually cooled to the temperature of liquid air all the bands shift towards the violet in a similar manner. The relation of intensities changes, but it is significant that the change is such as to produce a modification in the curve of relative intensities precisely similar to that which occurs with the ordinary broad continuous fluorescence bands when the excited substance is cooled. A continuance of the change which occurs in the fluorescence of uranyl salts as the temperature rises might result in the merging of the component bands into a continuous band. Indeed, in some of the uranyl salts there is ordinarily a considerable overlapping of the bands. The broad continuous bands of fluorescent substances are always associated with a broad absorption band usually overlapping the fluorescence band on its violet side. The absorption spectrum of the uranyl salts consists of a series of bands similar in arrangement and number to those of the fluorescent spectrum. Preliminary observations indicate that the enveloping curve of intensity for the absorption bands is an image of that for the group of fluorescence bands, just as the broad absorption band of resorufin and other fluorescent substances has already been shown to be the overlapping image of the corresponding fluorescence band. Not only is the envelope of the fluorescence group of the same type as the curve of energy distribution in ordinary fluorescence bands, but each component band has a similar distribution of energy. That the relation between the luminescence of solids and liquids and that of vapours is an intimate one is strongly suggested by comparison of the curves for uranyl salts with Wood's curves for the fluorescence of sodium vapour and Steubing's for that of oxygen. Moreover, the family resemblance of all these related cases of banded fluorescence spectra to the banded spectra of gases as described by Deslandres and Kayser and Runge is very strong. These numerous indications of a common property point to the possible attainment of some broader generalisation concerning the various types of radiation. A. E.

1023. *Ultra-violet and Infra-red Phosphorescence.* **W. E. Pauli.** (Ann. d. Physik, 34. 4. pp. 739–779, April 7, 1911. Jena Habilitationschrift.) —Details of the phosphorescence of thirty-three substances are given, including the effect upon the duration and intensity due to very high and low temperatures (max. 380°, min. —55° and —180° C.). The investigation was conducted photographically. The infra-red portion, which extends to 915 $\mu\mu$, covers new ground; the ultra-violet is on the same lines as the work of Lenard and Klatt. Excitation of the alkaline earths by Röntgen and kathode rays produces, generally speaking, the same emission as excitation by the zinc spark. But in many cases kathode-ray excitation causes a momentary phosphorescence extending far into the ultra-violet. Further, several substances show, with kathode-ray excitation, a visual glow differing in colour from that seen with daylight excitation; this phenomenon is ascribed by the author to intensification of individual spectral bands by the kathode rays. No phosphorescence could be observed in the case of zinc sulphide. A layer of liquid air 25 mm. thick is found to absorb all ultra-violet rays beyond 275 $\mu\mu$ (the emitting substance being preserved from direct contact with the liquid air). As a rule the intensity of all bands of Sr "phosphores" increases with duration of glow and with high temperature, especially in the case of SrBiNa. With some materials there are two different temperatures at which a band attains a maximum of intensity. The author finds his observations to be in conformity with modern theoretical views. Some notes on the preparation of phosphorescing mixtures are given. [See Abstract No. 286 (1911).] A. E.

HEAT.

1024. *Influence of Pressure on the Melting-points of Metals.* **J. Johnston** and **L. H. Adams.** (Amer. Journ. Sci. 31. pp. 501–517, June, 1911.)—The authors have built up an apparatus for the study of chemical and physical reactions at temperatures up to 400° C. and under pressures up to 2000 atmos., and, with the object of proving the precision of the temperature measurements under these conditions, have determined the freezing-points of Sn, Bi, Pb, and Cd, using a copper-constantan couple. Under 2000 atmos. the melting-point of tin is increased by 6·57°, that of lead increased by 12·6°, of cadmium by 16·08°, while that of bismuth is decreased by 7·19° C. Within the limits of experimental error the change of melting-point is a linear function of the pressure. The theoretical values of change of melting-point with pressure, calculated from the Clausius-Clapeyron equation, show a satisfactory agreement with the observed results. F. C. A. H. L.

1025. *Errors in Cooling Curves and Methods for avoiding these Errors. New Form of Crucible.* **H. C. Hayes.** (Amer. Acad., Proc. 47. No. 1. pp. 3–22. May, 1911. Contribution from the Jefferson Phys. Lab., Harvard Univ.)—The author has investigated the errors which occur in cooling curves carried out in the ordinary way by means of a thermo-couple, due to protecting tube lag, contact lag and lag in the junction, and shows that most cooling curves so far obtained are inaccurate. In some cases, *e.g.*, when the temperature lag is less than the ratio between the latent heat of melting and the average specific heat of the metal during the transformation, a correct result can be got from incorrect curves ; but in other cases, *e.g.*, allotropic change, this is not so. It is pointed out also that the usual method of correction by taking a cooling and a heating curve is not satisfactory, as the lag is not proportional to the rate of cooling, and, moreover, in the case of alloys changes go on, so that it is not certain that the alloy studied by the cooling curve is the same as that studied by the heating curve. To reduce the contact lag the author uses a special junction, of which the protecting tube forms one side. This can be protected by a lime coating (see *infra*). A complete apparatus is described. A special crucible is also described which consists of a Pt crucible lined with a thin layer of lime. This is obtained by heating a mixture of quicklime and calcium nitrate. A. F.

1026. *Determination of Specific Heats of Solids at Low Temperatures.* **H. Barschall.** (Zeitschr. Elektrochem. 17. pp. 341–345, May 1, 1911.)—The apparatus used is a modification of Dewar's [see Abstract No. 1757 (1905)]. The specimen is dropped into liquid oxygen, and the amount of gas liberated is determined. Care is taken exactly to determine, by means of an iron-constantan couple, the initial temperature of the substance, which is pre-cooled in a mixture of ether and solid CO_2 at about —75° C., and to ensure a direct fall of the substance into the liquid oxygen at about —183·5° C. The substance is divided into four portions, and these are dropped, at intervals of half a minute, through a device consisting of two perforated discs, the upper one of which can be turned about its vertical axis. In order to stir the liquid air, oxygen is passed through it, the tube being a flexible steel capillary, 0·7 mm. in diam., weighing 8·4 gm. per m. The experiments are being continued; so far they concern Ag, Pb, Cd, S, Br, HgI_2, PbI_2, $PbBr_2$. H. B.

1027. *The Initiation and Propagation of Explosions.* **H. B. Dixon.** (Chem. Soc., Journ. 99. pp. 588–599, April, 1911. Presidential Address.)—In this address to the Chemical Society the author contributes further results from the investigation of the ignition of gases, the method of starting combustion being that of adiabatic compression. The chief results given are: (1) If the piston is stopped artificially before the "ignition-point" is reached, a very slight combination is found to have occurred. (2) When the ignition-point is reached the gases unite sufficiently rapidly to self-heat the mixture (after the motion of the piston is stopped). (3) The gases, self-heated by this pre-flame combination to a temperature much above the ignition-point, burst into flame at some spot, from which the flame spreads throughout the column with a velocity depending on the nature of the mixture and on the extent of the compression. (4) If the piston is not checked when the "ignition-point" is reached, it continues to move forward until stopped by the explosion. If therefore the "ignition-point" is calculated from the position reached by the piston when stopped by the explosion, that temperature will be too high, except in those cases where the length of the pre-flame period and the time taken for the flame to spread are negligible. The most interesting result is the proof of the importance of the pre-flame period. By stopping the piston at different degrees of compression, the "ignition-point" for a mixture of 1 vol. of hydrogen and 8 vols. of oxygen was found to be between 550° and 578°. The duration of the pre-flame period was found of the order $\frac{1}{100}$ second. It is during this slow pre-flame combustion that water-vapour acts as an accelerator. It would seem that the flame marks the abrupt beginning of another mode of chemical combination which is independent of water-vapour. From experiments on the spread of the flame it would appear that, contrary to the view of le Chatelier, the mere heating of a mixture of explosive gases to the ignition-point by adiabatic compression does not necessarily set up the explosion-wave. To start the flame at all, the gas must be far above the ignition-point; and the author believes that the flame can advance as an explosion-wave when, not only a few, but the great majority of the molecules in the wave-front have sufficient translational energy to combine chemically on collision. The author also refers to the work which has been carried out on the explosion of coal-dust. A. F.

1028. *Heat of Evaporation of Oxygen.* **H. Barschall.** (Zeitschr. Elektrochem. 17. pp. 345–348, May 1, 1911.)—The method is that of Estreicher, 1904: a measured quantity of heat is electrically imparted to the liquid oxygen, and the volume of the gas generated is determined. The heater is the carbon filament of a glow-lamp (taken out of its bulb), 2 cm. in length, resistance at —183° C. 185 ohms; the heating lasts about 2 min., during which about 500 cm.^{3} of oxygen would be generated, the passage to the measuring vessel being left open for 5 min. Special care is taken to avoid undercooling of the glass. The resulting value, the mean of six very concordant determinations, 51·30 cals. per gm. of oxygen under a pressure of 763 mm., or 1641·6 cals. per gm.-mol (electrothermal equivalent = 0·239), agrees best with Alt's value 50·97; six determinations had been made since 1900, all except Behn's by electrical heating, and the resulting values ranged from 50·8 (Behn) to 61·0 (Shearer). H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1029. *Electronic Charge.* **J. Perrin.** (Comptes Rendus, 152. pp. 1165–1168, May 1, 1911.)—Stokes' law, even with Cunningham's correction, cannot be directly applied to molecular magnitudes unless the molecular particles are rigid spheres. Water-drops do not necessarily remain spherical when falling through air. The encounters with air molecules probably produce deformations and an internal circulation within the droplet. Millikan's value of $4{\cdot}9 \times 10^{-10}$ for the electronic charge is probably too high on this account. Rutherford and Geiger's value $4{\cdot}65 \times 10^{-10}$ is probably also too high. It is assumed, in dividing the charge transported by the number of impacts of α-particles observed, that all the charge observed is conveyed by these particles. This remains to be proved, and, in particular, the recoil of the remainder of the radio-active atom must be allowed for. Too much importance has been attributed to the concordance of the above high values, which may have been accidental. The electronic charge is probably lower. The Brownian motions indicate an upper limit of $4{\cdot}24 \times 10^{-10}$ e.s. unit. E. E. F.

1030. *Electronic Charge.* **J. Roux.** (Comptes Rendus, 152. pp. 1168–1169, May 1, 1911.)—Spherical charged particles are obtained by pulverisation of liquid sulphur. These solidify without crystallising, and can be followed, like Millikan's particles, for several hours in a microscope, slowly descending by gravitation, rising in an electric field, and sometimes suddenly parting with an electron under the observer's eyes. In applying Stokes' law, Millikan assumes that there is no recoil of the air particles from the droplets. But that assumption is improbable. If there is elastic recoil the numerical coefficient will be doubled, and the electronic charge, instead of being $4{\cdot}9 \times 10^{-10}$, will be $4{\cdot}4 \times 10^{-10}$. Observations on sulphur drops lead to the value $4{\cdot}17 \times 10^{-10}$, which is close to the value obtained from Brownian motions. E. E. F.

DISCHARGE AND OSCILLATIONS.

1031. *Ionisation of Salt Vapours by Kathode Rays.* **G. Moreau.** (Comptes Rendus, 152. pp. 1171–1173, May 1, 1911.)—The conductivity of a flame charged with an alkaline salt, measured between Pt electrodes, increases approximately as the square root of the concentration of the saline vapour, and increases with the atomic weight of the metallic base. The conductivity is greatly increased by covering the kathode with an oxide of an alkaline earth, and the concentration law thereupon ceases to apply, the ionisation of the salt being increased by the impact of the electrons emanating from the oxide. The author's method consists in introducing a Pt anode into one Bunsen flame and a kathode spread with oxide into another flame burning in contact with it. Into the combined flames a spray of pure water is injected, and subsequently a spray of the saline solution. With a field of 28 volts/cm., and a solution of KI of $\frac{1}{4096}$ mol./litre, the current observed was 114 microamps. With 0·5 mol./litre it was 455 microamps. It evidently tends rapidly towards a limit, which varies little with the salt used. With uncoated kathodes the current did not exceed 12 microamps. with a concentration of 0·5 mol./litre. [See Abstract No. 1178 (1904).] E. E. F.

1032. *Positive Ions from Oxidising Copper.* **A. Campetti.** (Accad. Sci. Torino, Atti, 46. 4. and 5. pp. 180–192, 1910–1911.)—Previous results are confirmed [see Abstract No 1064 (1907)], that a sheet of copper, during oxidation, emits positive charges. The mean velocity of the positive ions produced by the oxidation of copper at 500° in dry air is of the order 0·0016 cm./sec., about $\frac{1}{1000}$ that of the ions produced by Röntgen rays at the same temperature. This would signify that the ions produced by the oxidation of copper belong to the category of large ions, such as are formed upon the slow oxidation of phosphorus; and it shows that very massive ions (say of copper oxide) may, during particular chemical reactions, be formed and persist even at relatively high temperatures. A. D.

1033. *Electrical Conductivity in the Saturated Vapours of Alkali Metals.* **C. Füchtbauer.** (Phys. Zeitschr. 12. pp. 225–228, April 1, 1911.)—In a former paper it has been shown that in the saturated vapours of Na at a temperature lower than 200° C., a marked conductivity due to the Na vapour is observed [see Abstract No. 1277 (1909)]. A similar research with improved experimental arrangements has now been carried out with Cs vapour. Helium is the gas employed in the vacuum tube in which the effects due to the Cs vapour are measured. Curves are given which show (*a*) the increase of current at constant p.d. due to increase of temperature, (*b*) the current obtained at constant temperature with increasing p.d. With small p.d. the current appears to obey Ohm's law, then with increasing p.d. there are conditions under which an approximately saturation effect is obtained, and lastly, at still higher p.d., a very large increase in the current is observed owing to ionisation by collision. The results obtained are discussed, and it is concluded that the conductivity obtained with the alkali metals is a property peculiar to those metals, and is probably connected with their especially strong electro-positive nature. A. E. G.

1034. *Ionisation of Air produced by Quinine Sulphate.* **de Broglie.** (Comptes Rendus, 152. pp. 1298–1299, May 15, 1911.)—A very thin layer of ionised air, containing a high concentration of both positive and negative ions, is produced on the surface of quinine sulphate during variation in its hydration. The positive ions are usually in slight excess, and from their mobilities the ions must be small. The layer has no appreciable thickness either at atmospheric pressure or at a pressure of only 8 mm. of mercury, which may explain the difficulty of saturation. [See Abstract No. 475 (1911).] W. H. Sl.

1035. *Branch Currents in Discharge Tubes.* **J. Würschmidt.** (Deutsch. Phys. Gesell., Verh. 13. 9. pp. 859–878, May 15, 1911.)—The type of discharge tube adopted is one in which the main tube is about 40 cm. long and 4 cm. wide, and the branch tube, which is at the middle of the main tube and at right angles to it, is about half as long. It is found that branch currents are under similar conditions smaller when the electrode in the branch tube is the kathode than when it is the anode. The intensity is dependent upon the position of the branching point relative to light and dark part of the principal discharge, being greater when that point occurs at a light band than when it is at a dark one. It increases with increase in the strength of the principal current, with increasing potential, with diminishing pressure, and with decreasing length of the branch tube. Its increase gradually becomes more and more rapid, until suddenly a form of discharge is set up similar in kind to that passing in the principal tube. The distribution of potential in the branch tube is such that the gradient in the neighbourhood of the electrode is constant: as the branching point is approached it decreases, and in immediate proximity to that point it reaches a very small value. In the case of quite weak branch currents the greater part of the fall of potential occurs near the kathode. With the setting-up of the independent discharge a sudden alteration takes place in the distribution of potential. There is a sudden jump of potential at the electrode, which is greater when this latter is the kathode than when it is the anode. By using a Wehnelt kathode in the principal tube negative values of the branch current corresponding to negative potentials at branching point can be produced. This is a preliminary communication, and deals only with discharges through air at low pressures. Further work is in progress. **A. E. G.**

1036. *Magnetic Field due to Kathode Rays.* **A. Joffé.** (Ann. d. Physik, 34. 5. pp. 1026–1032, May 9, 1911.)—The researches of Hertz, v. Geitler, and E. Klupathy have failed to settle the question as to the magnetic action of the kathode rays. An experimental arrangement is now described by which all secondary effects due to the discharge are excluded, and the magnet system is placed under the action of the kathode rays, which can be simultaneously measured. The magnetic field due to the kathode rays is determined by the quantity of electricity which is transported per unit of time. It is concluded that the magnetic action due to kathode rays is equivalent to that produced by a current of equal density to within about 5 per cent. **A. E. G.**

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1037. *Electrical Conductivity of Argentic Sulphide.* **H. V. Hayes.** (Amer. Acad., Proc. 46. No. 22. pp. 615–621, April, 1911.)—Faraday, Hittorf, and Streintz (1902) had attributed the peculiar behaviour of silver sulphide to a negative coefficient of resistance for heat. The author distinguishes three conditions of the sulphide. The resistance appears at first extremely high, but decreases rapidly when the sulphide is heated; this heating may be effected by the current. In the second condition the cooled specimen does not attain more than a fraction of its original high resistance; yet the resistance is several times greater than in the hot state. After the current has been passed for some time or has been reversed, the specimen passes into the third condition, in which the resistance changes little with heat and with current density. The author traces the peculiarities to imperfect contact with the terminals. He forces electrodes of Pt, Ag, Cu, steel, foil or wire, under very high pressure into the rectangular plate of compressed sulphide. As long as the resistance is high sputtering noises are heard on a telephone in circuit. During condition I. the contact at the negative electrode improves; whether there is any electrolysis (Faraday and Hittorf) he does not know. During condition II. the contact at the positive terminal, which pressure alone cannot render perfect, improves owing to ionisation and arc formation. The temperature coefficient is probably positive after all. **H. B.**

1038. *Electromagnetic Action of Metallic Ions, deflected by a Magnetic Field.* **O. M. Corbino.** (Accad. Lincei, Atti, 20. pp. 342–344, March 5, 1911.)—A current is led by an axial wire *a* to the centre of a bismuth disc, to the circumference of this, then by brushes on a copper ring back to a metallic tube *t* surrounding *a*; round the copper ring is a coil *c* with galvanometer. The whole is fitted between electromagnet pole-pieces, of which one is pierced for *a* and *t*. The passage of the current from *a* causes no effect in the coil *c*. But if the galvanometer circuit be opened, the electromagnet field set up, the galvanometer circuit closed, and then the current be turned on in *a*, the galvanometer shows an abrupt deflection; and on turning the *a* current off the galvanometer shows an equal and opposed deflection. The direction of the deflection varies with that of the current in the disc of bismuth, as also with the direction of the electromagnet field; and there is no such induced current when for a disc of bismuth we substitute a disc of copper. These effects cannot be due to the mutual action of circuits, nor to derived currents, nor to variations in the magnetic properties of the bismuth on the passage of a current; they were, however, foreseen from the following considerations: In bismuth both positive and negative ions convey the current, particularly the negative ions; the path of these is radial in the absence of the electromagnet field; when this is set up the path becomes spiral, in the same direction for both positive and negative ions; but since the two currents and the two ion-velocities are unequal, there is set up a true magnetic field in the bismuth, revealed by the induced current in the coil *c*. This differs from the Hall-effect, with its resultant modified distribution of potential, in the distortion of the current-lines and the absence of a change in the potential distribution. With an electromagnet field of 1000 units and a radial current of 20 amps. in the bismuth disc, the deviation corresponded to a current of 0·2 amp. in a circuit the same size as the disc, and similarly placed. The direction of the deflection follows this rule: The passage of a centrifugal current in the disc, under the action of the field, transforms the disc into a magnetic lamina with the same sense of circuitation as the magnetising current; if the current be centripetal, then into a magnetic lamina with a circuitation opposed to that of the magnetising current. A. D.

1039. *New Galvanomagnetic and Thermomagnetic Effects.* **O. M. Corbino.** (Accad. Lincei, Atti, 20. pp. 416–423 and 424–428, March 19; 569–574, April 23, and pp. 746–749, May 21, 1911.)—A circular disc of bismuth, traversed by radial currents and introduced into a magnetic field normal to it, is transformed into a magnetic shell in which the current strength varies inversely as the distance from the centre [see preceding Abstract]. The effect is proportional to the Hall-effect and to the electric conductivity, and therefore varies from one metal to another much less than the Hall-effect. A disc 6 cm. in diam., traversed radially by 20 amps., and surrounded by a coil of 500 turns, gives a deviation of 8000 divisions in a good mirror galvanometer. Conversely, when the external field varies, a radial e.m.f. is induced in the disc, which, however, is not reversed on reversing the magnetic field. Further, a Bi disc, heated at the centre or the circumference, tends to rotate in a magnetic field, owing to the action of the Ettinghausen effect; and, lastly, a rotation is also observed in a disc bearing radial currents. These effects are best observed in bismuth, antimony, and tellurium. They are all accounted for by the electron theory of metallic conduction. [See Abstract No. 840 (1901).] E. E. F.

1040. *Dielectric Constants of Gases for High-frequency Electrical Oscillations.* **H. Rohmann.** (Ann. d. Physik, 34. 5. pp. 979–1002, May, 9, 1911.)—Two inductively-coupled circuits are brought into resonance. When they are in resonance, the quantity $\int_0^\infty i_1 i_2 dt = 0$ (where i_1, i_2 are the momentary currents in the two circuits). This quantity is determined by means of a "ring dynamometer" [see Abstract No. 1010B (1910)]. The primary circuit is excited by impact. The secondary contains a capacity, which is filled with different gases. The dielectric constants of these gases are compared by the resulting change in capacity; the change being determined by a compensation method. A variable capacity is placed in parallel with a small self-induction inserted in the secondary circuit and adjusted until again there is no deflection of the dynamometer ring. It is stated that changes in capacity can be determined by this method to 1 in 100,000. Hydrogen gas is used as a standard and by means of the relation $\delta c_2 = c_2(\epsilon - 1)(P - P')$ (where $c_2 =$ the secondary capacity, $\delta c_2 =$ the change of the secondary capacity, which results from a change in the pressure of the gas from P to P′, $\epsilon =$ the dielectric constant at 760 mm.) the dielectric constant of a gas is compared with that of hydrogen by noting the pressures, of this gas and of hydrogen, which bring about exactly the same change in the readings of the compensating capacity. Great care is taken to keep the temperature constant. The results, together with those of former observers, are given in the following table :—

Gas.	Rohmann.	Klemenčič.	Boltzmann.	Tangl.
Air	1·000580	1·000586	1·000590	1·000576
CO_2	1·000989	1·000985	1·000946	—
H	1·000282	1·000264	1·000264	1·000278
N	1·000606	—	—	1·000581
N_2O	1·001129	1·001158	1·000994	—
O	1·000547	—	—	—

T. P. B.

1041. *Dielectric Constant of some Liquid Hydrides.* **R. C. Palmer** and **H. Schlundt.** (Journ. Phys. Chem. 15. pp. 381–386, April, 1911.)—By the method of Drude the authors have determined the dielectric constants of ammonia, phosphine (PH_3), and stibine (SbH_3) in the liquid or solid state. Their results are as follows :—

Substance.	Temp. °C.	Dielectric Constant.	Temp. Coefft., Per Cent.
Ammonia	20·5	15·55	
Ammonia	24·5	14·9	
Ammonia (max. value)	—77	25·4	— 0·4
Ammonia (solid)	—90	4·01	
Phosphine	—60	2·55	+ 0·18
Phosphine	—25	2·71	
Phosphine (calculated)	20	2·91	
Stibine	—80	2·93	
Stibine	—50	2·58	— 0·4
Stibine (calculated)	20	1·76	

A. F.

1042. *Disappearance of the Electrical Resistance of Mercury at Helium Temperatures.* **H. Kamerlingh Onnes.** (Konink. Akad. Wetensch. Amsterdam, Proc. 14. pp. 113–115, June 28, 1911. Communication No. 122b from the Phys. Lab., Leiden. Electrician, 67. pp. 657–658, Aug. 4, 1911. Abstract.)—The author has made a more accurate determination of the electrical resistance of pure mercury [see Abstract No. 772 (1911)], the methods of overlapping shunts and of potential drop being employed. The previous measurements are confirmed, but, in addition, it is found that the actual resistance is much smaller than the upper limit previously ascribed to it. The mercury resistance used measured 172·7 ohms in the liquid condition at 0° C. (= 39·7 ohms in solid state, by extrapolation). At 4·3° K this had sunk to 0·084 ohm, and at 3° K was less than 3×10^{-6} ohm. The resistance at this temperature is thus one ten-millionth of that at 0° C. On raising the temperature the point at which the resistance first becomes measurable was found to be just above 4·2° K. The importance of the results, by which conductors of zero resistance are obtainable, is commented on. L. H. W.

ALTERNATING CURRENTS AND MAGNETISM.

1043. *The Work done in Magnetisation.* **A. Leduc.** (Comptes Rendus, 152. pp. 1243–1245, May 8, 1911.)—By the work done in magnetisation is meant the work W necessary to turn round the magnetic elements. Some write this $\partial W = (vH/4\pi)\partial B$...(1) and others $\partial W = M\partial H$ or $\partial W = Iv\partial H$...(2), where v gives the volume of the element subjected to the magnetising force, HM its magnetic moment, I the intensity of the magnetisation, and B the magnetic induction. The proper formula, however, is $\partial W = H\partial M$ or $\partial W = H\partial(vI)$. Two demonstrations are given. Mascart and Gerard give (2) and Houston gives (1). The errors they make are pointed out. A. R.

REFERENCES.

1044. *Inverse Force Relations between Electrodynamics and Hydrodynamics.* **H. Witte.** (Phys. Zeitschr. 12. pp. 347–360, May 1, 1911.)—A discussion, partly mathematical, of the relations asserted to exist between electrodynamics and hydrodynamical analogies with special reference to the views of Kelvin, C. A. Bjerknes, and V. Bjerknes. E. H. B.

1045. *Electron Theory and Thermo-electricity.* **F. Krüger.** (Phys. Zeitschr. 12. pp. 360–368, May 1, 1911.)—A mathematical paper in which thermodynamics is applied to the electron theory of thermo-electricity. [See Abstract Nos. 1641 (1905) and 152 (1911).] E. H. B.

1046. *Sparking Potentials between Concentric Cylinders.* **A. B. Meservey.** (Phil. Mag. 21. pp. 479–499, April, 1911.)—The results obtained in investigations of the potentials required to produce discharges in gases at low pressures are given. A. R.

1047. *Theory of Coupled Circuits.* **A. Kalähne.** (Jahrbuch d. Drahtlosen Telegraphie, 4. pp. 357–381, April, 1911.)—The paper deals with Cohen's method of calculating the frequency and damping of coupled circuits [see Abstract No. 1625 (1909)]. It is altogether mathematical and cannot be abstracted. T. P. B.

1048. *Electrostatic Voltmeter for Photographic Recording of Atmospheric Potential.* **G. W. Walker.** (Roy. Soc., Proc. Ser. A. 84. pp. 585–588, Feb. 15, 1911.)

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1049. *Decomposition of Water by Ultra-violet Light.* **A. Tian.** (Comptes Rendus, 152. pp. 1012–1014, April 10; Errata, ibid. p. 1196, May 1, 1911.)—Continuing his research on the decomposition of water by ultra-violet light [Abstract No. 420 (1911)], the author concludes that under the action of the total radiation from a quartz mercury lamp, water is decomposed into hydrogen and H_2O_2, which, decomposing in its turn, gives oxygen. At the end of a sufficient time the effect of the light is identical, as regards the gases set free, with that of electrolysis. [See also Abstract No. 1685 (1909).] **A. W.**

1050. *Chemical Action of Kathode and Canal Rays.* **E. P. Perman.** (Chem. Soc., Journ. 99. pp. 833–840, May, 1911.)—One of the special objects of the research was to see whether the rays could produce transmutation of the elements such as is claimed by W. Ramsay for RaEm. The electrodes were of Al, but special kathodes and anodes of copper, &c., in contact with the real electrodes were also used. No trace of any transmutation was produced by kathode or canal rays in anhydrous copper sulphate (free of Li), Cu, copper nitrate, Th, Ur; sometimes traces of alkali (probably from the glass) were found, but Li, He, CO_2 were never detected. As regards the chemical action of canal rays, they have a strong oxidising effect on cuprous oxide, lead sulphide, and litharge in air and in oxygen; the reduction of cupric oxide, produced in hydrogen or coal-gas, was less marked; ferric and mercuric chlorides and potassium chlorate were reduced in air; ammonia was formed from N and H, but no nitride from Mg and N; hydrocarbons (vaseline smeared on glass) were oxidised. The effect is much more rapid in the direct beam than outside it, but there is some scattering. The oxidation does not appear to be due to a formation of ozone. In most cases the action is of the character of a decomposition; potassium chloride is turned violet by canal rays as by kathode rays. **H. B.**

1051. *Alloys of Nickel and Cobalt with Chromium.* **E. Haynes.** (Journ. Ind. and Engin. Chem. 2. pp. 397–401, 1910. Chem. News, 103. pp. 201–203, April 28, 1911.)—Gives some account of the properties of these alloys made on an experimental scale. The colour of the Co-Cr alloys is between that of steel and silver. These alloys have a remarkable resistance to corrosion, being equalled in this respect only by gold and the Pt metals. Nitric acid and solutions of caustic alkalies are without action on some of these alloys which are likewise proof against all atmospheric influences. On heating in air they retain their colour up to 500°, when a faint straw-colour appears which deepens as the temperature rises; no scale is formed even when heated to bright orange. Various suggestions as to the uses of these alloys are made. **C. O. B.**

1052. *Alloys of Mo with Ni, Mn with Tl and Ca with Mg, Tl, Pb, Cu and Ag.* **N. Baar.** (Zeitschr. Anorg. Chem. 70. 4. pp. 352–394, May 15, 1911.)—The author has investigated the systems formed by these pairs of metals by the methods of thermal analysis, confirming the results where possible by microscopic analysis. Most of the Ca alloys, however, and especially the calcium-rich ones, are so readily attacked by water, falling to powder in the atmosphere, that it is impossible to prepare sections for microscopic examination. *Molybdenum-Nickel alloys*, investigated up to 70 per cent. Mo are completely miscible in the liquid and in the solid Ni retains 33 per cent. Mo in solution. At 1842° the compound NiMo is formed by a reaction between the liquid and Mo, while the corresponding eutectic contains 49·7 per cent. Mo and freezes at 1297° C. *Manganese-Thallium* are immiscible in the liquid between 0 and 94·6 per cent. Mn and in the solid between 0 and 98 per cent. Mn. Up to 6·4 per cent. the addition of Tl gradually lowers the freezing-point of Mn to 1200° C., after which it remains constant. *Magnesium-Calcium* form a compound Mg_4Cd_3 corresponding to a maximum in the curve at 715° C. This forms two eutectics, one with Mg at 514° C. containing 18·7 per cent. Ca and the other with Ca at 446° C. containing 78·7 per cent. Ca. The compound is very brittle and does not decompose water so rapidly as the remaining alloys. *Calcium-Thallium* form three compounds: CaTl corresponding to a maximum at 969° C., Ca_3Tl_4 by the reaction of CaTl with the liquid at 555° C., and $CaTl_3$ by interaction of Ca_3Tl_4 and liquid at 525° C. Solid solutions are formed at both ends of the series, and the CaTl-thallium eutectic contains about 41 per cent. Ca and solidifies at 692° C. *Calcium-Lead.*—Lead lowers the freezing-point of Ca to a eutectic at 702° C. containing 89 atoms per cent. Ca, but Ca at once raises the freezing-point of lead. Two compounds $PbCa_2$ and Pb_3Ca correspond to maxima at 1105° C. and 650° C., while PbCa is formed on cooling by the interaction of $PbCa_2$ and liquid at 950° C. The PbCa-Pb_3Ca eutectic solidifies at 626° C. with 86 atoms per cent. Ca. *Calcium-Copper* are completely miscible in the liquid and form one compound Cu_4Ca corresponding to a maximum at 933° C. This forms a eutectic with Cu at 910° C. containing 5·7 per cent. Ca and a eutectic with Ca at 560° C. containing 88 per cent. Ca. Alloys between 28·5 and 90 per cent. Ca show slight thermal effects at 480° C. the maximum being at 70 per cent. Ca. *Calcium-Silver* are completely miscible in the liquid. Calcium lowers the melting-point of Ag to a eutectic containing 18·5 atoms per cent. Ca at 650° C., while Ag lowers that of Ca to a eutectic at 470° C. with 80·5 atoms per cent. Ca. The remainder of the curve shows 2 maxima at 726° and 665° C., corresponding to the compounds Ag_3Ca and AgCa respectively. At 683° C. the compound Ag_3Ca reacts with the Ag-rich liquid to give the compound Ag_4Ca, and at 595° C. it reacts with the Ca-rich liquid to give the compound Ag_2Ca. The Ag_2Ca-AgCa eutectic crystallises at 545° C. containing 39·4 atoms per cent. Ca. Between 50 and 70·5 atoms per cent. Ca, solid solutions which split up at lower temperatures into the compounds AgCa and $AgCa_2$, are found. The violence with which Ca reacts with the metals increases with the atomic weight. Calcium is completely miscible with almost all metals (except Cd and Al) in the liquid, is not very prone to form solid solutions, but gives a large number of compounds and tends to give rise to compounds of the type Me_2Ca and MeCa. A table showing the metallic compounds of Ca which have been investigated is given at the end of the paper. F. C. A. H. L.

1053. *Solid Solutions of Copper-Nickel produced by Diffusion of the Metals in the Solid State.* **G. Bruni** and **D. Meneghini.** (Accad. Lincei, Atti, 20. pp. 671–674, May 7, 1911.)—A piece of Ni wire, 20 cm. long and 0·5 mm. in diam., on which is electrically deposited sufficient Cu, in as compact a form as possible, to form 60 per cent. of the total mass, has been subjected to prolonged heating to 1000° C. in an atmosphere of hydrogen in an electric furnace, and the electric resistance measured at intervals, after cooling to about 15° C. The resistance, initially 0·0260 ohm, falls after the first two hours' heating, to 0·0256 ohm, but then begins to increase, at first slowly, then more rapidly, and finally after about 135 hours, approaches a constant value of about 0·2105 ohm, corresponding to a conductivity of $2·07 \times 10^4$ mhos, which agrees closely with the value $2·0 \times 10^4$ at 0° C. found by Feussner for a Ni-Cu alloy containing 58·61 per cent. Cu. From these results it is concluded that Cu and Ni are able to diffuse into each other in the solid state. W. H. Si.

1054. *Study of Iron-Chromium Alloys with Special Reference to their Acid-resisting Properties.* **P. Monnartz.** (Metallurgie, 8. pp. 161–176, March 22, and pp. 193–201, April 8, 1911.)—Since the carbon-chrome iron alloys with high Cr-content are known to be capable of resisting the action of acids to a considerable degree the author has investigated the pure Fe-Cr alloys and has determined the effects of other elements. Twenty-one alloys containing 3·8 to 98·2 per cent. Cr were prepared by the aluminothermic reaction, using a 10 per cent. deficiency of Al so that the impurities present only amounted to 0·4 to 0·65 per cent. Cooling curves were taken on masses of 1200 gm., and the equilibrium diagram shows a maximum at about 1640° C. corresponding to the compound Cr_2Fe. In the absence of carbon the alloys can be readily turned and drilled, but the alloys containing high carbon possess great hardness. For casting, the alloys were prepared in a Goldschmidt crucible provided with a tapping arrangement similar to that of a steel casting ladle, the tapping hole being arranged immediately above the gate of the mould which could thus be filled without enclosing and trapping gases, so that perfectly sound castings resulted. The alloys were subjected to the action of hydrochloric acid, sulphuric acid, nitric acid with and without chlorides and to weathering. Like iron, Cr possesses the property of assuming a passive state under certain conditions, the temperature at which this property is lost depending on the strength of the nitric acid. The presence of alkaline chlorides in the nitric acid also destroys the passive state. Addition of Cr to iron apparently increases the solubility in hydrochloric and sulphuric acids, but as regards their action towards dilute nitric acids the alloys are to be divided into five classes: (1) Up to 4 per cent. Cr the resistance to dilute nitric acid diminishes, but increases to strong nitric acid; (2) from 4 to 14 per cent. Cr the stability to dilute nitric acid increases with great rapidity; (3) from 14 to 20 per cent. Cr the resistance increases slowly but almost proportionally with the Cr-content; (4) from 20–40 per cent. Cr the resistance is almost equal to that of Cr (the alloys dissolve in dilute nitric acid containing 5 per cent. common salt in the cold); (5) from 40 to 100 per cent. Cr the alloys are not only stable towards pure nitric acid but resist the action of the nitric acid salt mixture. The max. passivity appears to be at about 65 per cent. Cr [Cr_2Fe]. Above 40 per cent. Cr the alloys resist atmospheric action, the action of river-water, and are not greatly affected by cold sea-water. The presence of carbon increases the resistance to acids owing to the formation of the double carbide, but this increase in resistance is accompanied by an enormous increase in hardness. Small quantities of Ti, V, W, and Mo, especially the two latter, increase the stability in acids, and by decreasing the size of the grain confer greater strength without hardening. Manganese diminishes the stability to acids. The presence of oxygen is essential to the attainment of a passive state; the passivity of iron can be induced by making it an anode, and can be increased by treatment with nitric acid and oxygen under pressure. Since chromium is not attacked by nitric acid at any temperature, it can be regarded as a noble metal so far as this acid is concerned, and the explanation of the passivity of the Fe-Cr alloys would appear to lie in the formation of galvanic cells between the Fe and Cr particles, oxygen being separated on the iron which becomes passive when the concentration of oxygen becomes high enough. Consideration of other systems of a noble metal such as Au, Pt, Cr with carbon and Si and metals capable of assuming passivity (Fe, Ni, Sn, and Co), shows the above explanation to be correct. The resistance of metals to the action of acids is of two classes: (1) due to an inherent nobleness of the metal, and (2) due to the presence of oxygen in sufficient quantity to induce passivity. As a general rule acid-resisting alloys either possess mechanical properties which exclude all possibility of working, or only become passive under unfavourable conditions; but since it has now been proved that carbonless chrome-iron alloys combine superior passivity with good mechanical properties, the phenomenon will receive greater consideration for industrial purposes. F. C. A. H. L.

1055. *Gases contained in Steels.* **G. Charpy** and **S. Bonnerot.** (Comptes Rendus, 152. pp. 1247–1250, May 8, 1911.)—During the course of researches on cementation the authors have been able to effect a series of experiments on the gases liberated when steels are heated to 950° C. *in vacuo.* Under these conditions the velocity of liberation diminishes rapidly during the first few hours, but afterwards reaches a limit, indicating that part of the gas is liberated by a progressive reaction and is not wholly dissolved or occluded. The initial velocity of evolution is greater with small chips and decreases with increase of pressure, but the ultimate total volumes liberated from equal weights of the same steel are the same. Using different weights of the same metal the ratio of the volumes liberated is small compared with the ratio of the weights, and tends to diminish with the time. The volume of gas evolved from 1 gm. of steels of the two extremes of hardness was as follows:—

	Volume of Gas in Air.	
	After 5 Hours.	After 3½ Days.
Hard Martin steel (0·9 per cent. carbon)	0·65	0·98
Hard electric steel (1·05 „ „)	0·55	0·75
Hard crucible steel (1·20 „ „)	0·58	0·69
Soft electric steel (0·10 „ „)	0·24	0·31
Soft Martin steel (0·10 „ „)	0·29	0·41
Extra soft Martin steel (0·07 per cent. carbon)	0·40	0·70
Extra soft Thomas steel (0·04 „ „)	0·79	1·06

The gases contained 26 to 32 per cent. CO. Determination of the critical points after the extraction of the gases showed that neither the temperature nor the intensity of the heat evolution is affected. F. C. A. H. L.

1056. *Solid Non-metallic Impurities in Steel.* **H. D. Hibbard.** (Amer. Inst. Mining Engin., Bull. 52. pp. 325–344, April, 1911.)—Deals in a general manner with the presence of solid non-metallic impurities in steel, for which the author suggests the name "sonims." These include the oxides, sulphides, and silicates of iron and manganese. An experiment on the deoxidation of a charge of steel by ferrosilicon instead of ferromanganese is described in which the teamed metal exhibited extreme red-shortness owing to the presence of silica. The scum found on ingots is examined and analyses are given showing the elimination of impurities in this scum. The effect of varying quantities of non-metallic impurities and the condition in which they exist in the metal is discussed, and the methods which have been suggested for their elimination receive some attention. It is also pointed out that corrosion is greatly assisted by the presence of these impurities, especially oxide of iron. C. O. B.

1057. *Action of Steam on Iron at High Temperatures.* **J. A. N. Friend, T. E. Hull,** and **J. H. Brown.** (Chem. Soc., Journ. 99. pp. 969–973, May, 1911.)—A careful study of the reaction between steam and red-hot iron was made by the authors. The iron, in the form of thin wire, was heated in a current of pure hydrogen and cooled *in vacuo*, and then hammered out to a thickness of 0·05 mm. A weighed quantity was placed in a porcelain boat and heated in a silica tube in a gas furnace to different temperatures. Steam was supplied from a flask of boiling potash solution and the steam heated to the temperature of the furnace before it reached the iron. The temperature was measured by a resistance pyrometer, which was checked from time to time. The progress of the reaction was followed by observing the gain in weight of the iron, the heating, continued for different times and at different temperatures, ranging from 500°, 650°, 720°, 820°, and 950° C. The results obtained showed that at 500° C. the reaction between the steam and iron is so superficial that a practically infinite time would be required for its completion, and at 820° C. the reaction proceeds until the whole of the metal is converted into ferrosoferric oxide. By plotting the time against the weight of oxygen combined with 100 gm. of iron it was seen that the curves became parallel to the time axis, and from this the authors show that certain conclusions as to the dissociation pressures of the oxides may be drawn. F. J. B.

1058. *Relation between Density and Concentration of Aqueous Solutions.* **P. F. Gaehr.** (Phys. Rev. 32. pp. 476–491, May, 1911.)—The densities of aqueous solutions of common salt may be represented by the formula $\log \delta = mc$, where δ = density and c = concentration. Of the solutions studied it was found that the solutions whose max. concentration is less than 15 per cent. obey the law very well; of the others, about one-half obey the law within 0·6 per cent. Of those that are listed in the paper, about half are electrolytes and the other half are not, and the electrolytes seem to be mostly confined to the linear solutions. The number of salts studied was not great enough to permit any very definite general conclusions to be drawn. T. M. L.

1059. *Thermodynamic Calculation of E.M.F.'s.* II. **H. F. Halla.** (Zeitschr. Elektrochem. 17. pp. 179–182, March 1, 1911.)—The author states that Magnus, with the aid of a modified formula of Einstein, has succeeded better than he himself in discussing the principles of elements containing solids at the bottom of the cell in accordance with Nernst's theorem [see Abstract No. 1051 (1910)], and he describes new experiments with cells of the type Ag | AgBr—$PbBr_2$(both saturated) | Pb or the corresponding iodides. These cells are more difficult than the chloride combinations [see Abstract No. 191 (1909)]. When attempting to coat silver wire (after Jahn) with Br (or I) in HBr against a silver kathode, he obtained dark-coloured perhalides; in KBr and a little HBr and with a p.d. of 1 volt the halides remained almost white. The lead kathode is a lead amalgam (3 per cent. of Pb). The measurements of the bromide elements, made at eight temperatures ranging from 0° to +71° are in excellent agreement; those with the iodides (—71° to +62°) are not quite so concordant. The calculation according to Nernst's theorem has not been made yet. H. B.

1060. *Electrolytic Potential of Hyposulphite Reactions.* **K. Jellinek.** (Zeitschr. Elektrochem. 17. pp. 157–176, March 1, 1911.)—The investigation concerns in the first instance the potential of the formation of hyposulphite from the pyrosulphite $Na_2S_2O_5$ (which combines with water to $2NaHSO_3$, the reaction $S_2O_4'' + H_2O \rightleftarrows S_2O_5 + H_2$. The concentration of the ions are derived from the conductivity measurements by the author (Zeitschr. Phys. Chem. 76. p. 257, 1911). It results that the equilibrium pressure of the hydrogen at an electrode hyposulphite/bisulphite is independent of the concentration of the hydrogen ion, and, with normal concentrations of HSO_3 and of S_2O_4' amounts to 2 atmos.; the hyposulphite has hence the same reducing power as hydrogen. A fairly definite potential is established at a Pt electrode in alkaline solutions of hyposulphite and bisulphite, but the nature of the reaction is not clear; definite potentials were not found in alkaline solutions of hyposulphite (or sulphite) and thiosulphate, nor in acid solutions of thiosulphate and bisulphite. H. B.

1061. *Electrolytic Preparation of Hyposulphite from Solution of Bisulphite.* **K. Jellinek.** (Zeitschr. Elektrochem. 17. pp. 245–261, April 1, 1911.)—The investigation clears up the so-far obscure electrolytic reduction of sodium hydrogen sulphite (bisulphite) to hyposulphite (or hydrosulphite). It was known that this production of hyposulphite ceased when the solution contained about 4 per cent. of the hyposulphite; but it was not clear, whether the process stopped on account of a further electrolytic reduction or of a spontaneous decomposition of the product (hyposulphite). The author demonstrates that sodium hyposulphite, $Na_2S_2O_4$, is spontaneously decomposed (in the presence of bisulphite, $NaHS_2O_3$) into thiosulphate ($Na_2S_2O_3$) and $Na_2S_2O_5$; the latter combines with $1H_2O$ again to $2NaHS_2O_3$. This change remains unaffected, in solutions of technical concentration, by the electrolysis with lead or platinum kathodes. The hyposulphite is not itself reduced electrolytically, therefore, and higher concentrations of this product are obtained, when the electrolysis is carried on with the aid of high current-density and good cooling and stirring at such a rate, that the electrolytic formation exceeds the spontaneous decomposition. The technical preparation of hyposulphite from concentrated bisulphite and zinc dust may hence be likened to an electrolysis at extraordinarily high current intensity. H. B.

1062. *The Element Cu | Cu_2O . Alkali | H_2 at 0°.* **A. J. Allmand.** (Chem. Soc., Journ. 99. pp. 840–845, May, 1911.)—The author had determined [see Abstract No. 205 (1910)] the e.m.f. of the element at room temperature and had found 0·478 volt for the N/10-NaOH, and 0·466 volt for the N/1-NaOH. According to Nernst's theorem the former value should have been 0·472; but this calculation had involved an extrapolation which Nernst himself deprecated. The author hence repeats his determination at 0° C. with N/1-NaOH. The value found is 0·478 volt, while the calculation according to Nernst would yield 0·462 volt; the agreement is hence less satisfactory than previously assumed. The electrode temperature coefficients of O_2 and H_2 against normal caustic soda are also determined. H. B.

1063. *Potential of the Chlorine Electrode.* **G. N. Lewis** and **F. F. Rupert.** (Amer. Chem. Soc., Journ. 33. pp. 299–307, March, 1911. From the Research Lab., Mass. Inst. Technology, No. 64.)—The chlorine potential had been determined by Wilsmore in 1900 and by E. Müller in 1902 [see Abstract No. 1398 (1902)]. The value of the latter is confirmed, provided a correction be made for the hydrolysis of chlorine. The authors pass chlorine gas, diluted with air to a partial pressure of from 0·008 to 0·2 atmo., through hydrochloric acid, into which dips an electrode of Pt-Ir. The normal electrode is separated from the electrolyte by interposition of solution of KCl; the interdiffusion of the electrolytes causes the e.m.f. to fluctuate, and readings should be taken quickly and not after long waiting. From the observed values the electrode potential of chlorine gas at atmospheric pressure in the chlorine ion at normal concentration was calculated by two methods and yielded the value —1·0795 volts. H. B.

1064. *Standard Electrode with Alkaline Electrolyte: Hg | HgO . Alkali.* **F. G. Donnan** and **A. J. Allmand.** (Chem. Soc., Journ. 99. pp. 845–856, May, 1911.)—Having shown that the two oxides of mercury, the yellow and the red, are identical, and that all discrepancies in their electromotive behaviour are due to particles of different degrees of fineness, the authors find that the mercury oxide yields well-defined alkali normal electrodes. Combinations of the type $Hg \mid Hg_2Cl_2 . KCl \mid ROH . HgO \mid Hg$ are measured at 25° and 0°; the single potentials, assuming Planck's liquid potential formula to hold, are $Hg \mid HgO . N/1\text{-}KOH = +0{\cdot}1100$, the same in $N/1\text{-}NaOH = +0{\cdot}1135$, and $Hg \mid HgO . N/10\text{-}NaOH = +0{\cdot}1698$ volt; the difference in the temperature coefficients of the normal and decinormal electrodes agrees with the calculated values. The heat of reaction $H_2 + HgO \longrightarrow Hg + H_2O$ at 18° C., resulting from the electrochemical data, is 46,750 cals., while the thermochemical calculation gives 46,700 cals. H. B.

1065. *Electrochemical Behaviour of Tin.* **F. Foerster** and **J. Yamasaki.** (Zeitschr. Electrochem. 17. pp. 361–374, May 1, 1911.)—The authors determine the potential of tin in its salt solutions. The stannous chloride and sulphate incline to the formation of complex compounds. The potentials $Sn^{\cdot\cdot}/Sn^{\cdot\cdot\cdot\cdot}$ are variable, as Dolch had found for alkaline solutions, also in neutral and in weakly acid (less so in strongly acid) solutions, because the $Sn^{\cdot\cdot\cdot\cdot}$ concentration is gradually diminished by hydrolysis. The electrolytic reduction of the chloride solution in hydrochloric acid by means of kathodes of platinised Pt, grey or black, is slow at ordinary temperature; it should be conducted at higher temperature in concentrated solutions containing much HCl.

H. B.

REFERENCES.

1066. *Relation of Osmotic Pressure to Temperature.* III. **H. N. Morse, W. W. Holland,** and **E. G. Zies.** (Amer. Chem. Journ. 45. pp. 383–396, April, 1911.) IV. **H. N. Morse, W. W. Holland,** and **C. N. Myers.** (Ibid. pp. 517–536, May, 1911.)—[See Abstract No. 805 (1911).]

1067. *Electrical Induction in Chemical Reactions.* **L. G. Winston.** (Amer. Chem. Journ. 45. pp. 547–558, June, 1911.)—It is suggested that electrostatic induction may play an important part in chemical change. Several cases of chemical change are discussed from this point of view. T. M. L.